NACA TN 2792

# NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

## TECHNICAL NOTE 2792

# DIRECT-READING DESIGN CHARTS FOR 24S-T3 ALUMINUM-ALLOY FLAT COMPRESSION PANELS HAVING LONGITUDINAL FORMED HAT-SECTION STIFFENERS AND COMPARISONS WITH PANELS HAVING Z-SECTION STIFFENERS

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On page 14, the discussion is considerably confused because of the use in a number of places of the phrase "Z-stiffened panel" instead of the correct phrase "Z-section stiffener." This phrase should be corrected in the following lines, all on page 14, so that they read as follows:

Line 5: "twisting of the Z-section stiffener did not seem to be as serious as the"

Line 7: "Although the Z-section stiffener always does twist as failure occurs, even"

Line 13: "of the Z-section stiffener really occurs only after the maximum load has"

Line 24: "readily be explained, even if twisting of the Z-section stiffener is"

Lines 26-27: "can be made from Z-stiffened panels by turning every other Z-section stiffener around and joining the outstanding flanges together so that the"

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## SUMMARY

Direct-reading design charts are presented for 24S-T3 aluminum-alloy flat compression panels having longitudinal formed hat-section stiffeners. These charts make possible the direct determination of the stress and all panel proportions required to carry a given intensity of loading with a given skin thickness and effective length of panel. A comparison is made of the relative merits of hat- and Z-stiffened panels when used for carrying simple compression and when used as the covers of box beams which are subjected to compression plus bending and to compression plus bending plus vertical shear.

## INTRODUCTION

Design charts for wing compression panels have been presented in several different forms. (See refs. 1 and 2.) In reference 3, a form was presented which permitted the direct selection of the various panel proportions for given values of the principal design conditions - intensity of loading, skin thickness, and effective length of panel. This form also made possible the ready determination of the proportions having minimum weight to meet these conditions.

In the present paper, similar direct-reading design charts are presented for 24S-T3 aluminum-alloy flat compression panels having longitudinal formed hat-section stiffeners. These charts are based on the extensive test data of references 4 to 6. The structural efficiency of the hat-stiffened panel as evidenced by the charts is then discussed relative to the efficiencies previously found for Z-stiffened panels both when used for carrying simple compression and when used as the covers of box beams which are subjected to compression plus bending and to compression plus bending plus vertical shear.

## SYMBOLS

The symbols used for the panel dimensions are given in figure 1. In addition, the following symbols are used:

| | |
|---|---|
| $c$ | coefficient of end fixity as used in Euler column formula |
| $d$ | rivet diameter, in. |
| $L$ | length of panel, in. |
| $p$ | rivet pitch, in. |
| $P_i$ | compressive load per inch of panel width, kips/in. |
| $r$ | all bend radii, in. |
| $\bar{t}$ | cross-sectional area per inch of panel width, expressed as an equivalent or average thickness, in. |
| $\rho$ | radius of gyration, in. |
| $\bar{\sigma}_f$ | average stress at failing load, ksi |
| $\sigma_{cr}$ | stress for local buckling of sheet, ksi |
| $\sigma_{cy}$ | compressive yield stress, ksi |

## DIRECT-READING DESIGN CHARTS

Direct-reading design charts are presented in two forms in figures 2 to 13 for 24S-T3 aluminum-alloy flat compression panels with longitudinal formed hat-section stiffeners having the properties and proportions given in tables 1 to 7. Values of the ratios of stiffener thickness to skin thickness $t_W/t_S$, average spacing of rivet lines to skin thickness $S/t_S$ (because there are two rivet lines associated with each hat section, the stiffener spacing $b_S$ plus the distance between rivet lines $b_R$ equals $2S$), and height of stiffener to stiffener thickness $H/t_W$, which will satisfy a given set of design conditions, may be found directly from these charts, and the corresponding dimensions and section properties $b_R/t_W$, $\bar{t}/t_S$, $\bar{H}/t_S$, and $\rho/t_S$ may be found from tables 2 to 7.

The data on which the design charts are based covered four values of the ratio of stiffener width to stiffener height $b_H/b_W$, namely 0.6, 0.8, 1.0, and 1.2. Analysis of the results indicated that variations in $b_H/b_W$ were of little significance, just as it was found in reference 2 that variations in the flange widths of Z-sections are of little significance; accordingly, $\frac{b_H}{b_W} = 0.8$ was selected as a representative value and the charts were prepared for this value only. Curves which show how a variation in $b_H/b_W$ affects the section properties are given in figure 14.

First form of design chart.- In the first form of design chart (figs. 2 to 7), the design conditions of intensity of loading, skin thickness, and effective length of panel are incorporated in the ordinate $P_i/t_S$ and the abscissa $\frac{P_i}{L/\sqrt{c}}$. This form, having the design conditions incorporated in the ordinate and abscissa, is more useful than the alternate form for most design purposes because the curves are more widely spaced and interpolation is more straightforward.

Second (alternate) form of design chart.- In the second (alternate) form (figs. 8 to 13), the average stress at failure $\bar{\sigma}_f$ is plotted against $P_i/t_S$ as was done in the summary plots of reference 7. This alternate form, having the stress (an inverse measure of weight for a given load) as ordinate, is more useful for making generalizations and comparsions of structural efficiency than the first form because it indicates how nearly the stress actually carried approaches the upper limit corresponding to the stress that would be achieved by a pure shell construction, if a pure shell could carry the load without failure. This upper limit of stress is represented by the lines for $\bar{\sigma}_f = \frac{P_i}{t_S}$ (infinite stiffener spacing) in figures 8 to 13.

Color and line conventions used on charts.- Because there are several different quantities presented simultaneously on the design charts, several line and color conventions have been used to distinguish among them. For example, in the first form of design chart (figs. 2 to 7) dashed lines are used to indicate values of average stress at failure $\bar{\sigma}_f$; whereas, on the alternate form of design chart (figs. 8 to 13) dashed lines are used to indicate values of $\frac{P_i}{L/\sqrt{c}}$. In both forms the value of $\bar{\sigma}_f$ corresponding to the point at which each curve is cut by a short heavy line is the value of the stress for local buckling $\sigma_{cr}$

for the proportions represented by the curve. For example, the value of $\sigma_{cr}$ for $\frac{H}{t_W} = 20$ and $\frac{S}{t_S} = 19.9$ in figure 2 is approximately 29 ksi. (Only a very short panel of these proportions would buckle before failure - one having a value of $\frac{P_i}{L/\sqrt{c}} \geqq 0.47$.) If the value of $\sigma_{cr}$ is so low that the short heavy line would fall outside the boundaries of the chart, a numerical value of $\sigma_{cr}$ is given and is associated with the proper proportions by a leader to the curve. The panel proportions which have minimum weight are indicated on both forms of these charts by the use of colors as follows:

(1) If the proportions correspond to a blue line or region, they are the proportions which give the lightest possible 24S-T3 hat-stiffened panel which will meet the design conditions

(2) If the proportions correspond to a red line or region, they are the proportions which give the lightest possible 24S-T3 hat-stiffened panel at the ratio of stiffener thickness to skin thickness given by that particular chart, but some other thickness ratio would give a lighter design

(3) If the proportions correspond to a white region, the 24S-T3 panel will meet the design conditions but will not be the lightest panel which will meet the conditions

Because in many cases the proportions may be varied somewhat from those indicated by the red and blue colors with little change in the value of the stress that can be carried, too much importance should not be attached to the exact proportions indicated by the colors to have minimum weight. In any particular case for which a deviation from the minimum-weight proportions is made, however, caution dictates that the weight penalty associated with this deviation be determined.

Minimum-weight designs.- As an adjunct to the design charts themselves, the stresses achieved by the panels having the proportions indicated in the design charts to have minimum weight are summarized in figures 15 and 16 for use in weight or efficiency studies. Figure 15 covers the most general case, in which no minimum skin thickness is required. In this case curves of $\overline{\sigma}_f$ plotted against the structural index $\frac{P_i}{L/\sqrt{c}}$ measure the panel structural efficiency. This figure also demonstrates the stated insignificance of a variation in $b_H/b_W$.

Since the skin thickness of wing compression panels is often fixed by the requirements of adequate torsional stiffness of the wing, curves

which show the effect of a variation in sheet thickness also provide a useful evaluation of the relative structural efficiencies of stiffened panels; accordingly, figure 16 was prepared. In this figure, the average stress corresponding to that for minimum weight (as determined by the procedure given in ref. 7, appendix A) is plotted against the parameter $P_i/t_S$ for a series of values of $\frac{P_i}{L/\sqrt{c}}$ for $\frac{b_H}{b_W} = 0.8$.

## USE OF THE DIRECT-READING DESIGN CHARTS

The manner of using the direct-reading design charts depends in some measure on the desired degree of precision of interpolation among the curves. For many purposes, interpolation by inspection is of adequate accuracy, and the use of the charts requires only the calculation of the values of the design parameters $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ to permit the desired proportions to be read directly from the curves. The proportions for minimum weight, moreover, may be found directly as those corresponding to the blue region of the curves.

If more accurate interpolation is desired, a plot can readily be made of $H/t_W$, $\bar{\sigma}_f$, and $\sigma_{cr}$ against $S/t_S$ at the given values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ and the proportions can be picked from it. (This plot is similar to that which results from the use of the minimum-weight design procedure with the previously available design charts, refs. 2 and 7.) On a plot of this type, the proportions for minimum weight correspond to those associated with the highest value of $\bar{\sigma}_f$.

As a check on the accuracy of interpolation, the cross-sectional area per inch of width of the design may be determined from the values of $\bar{t}/t_S$ given in tables 2 to 7, and the value of the intensity of loading $P_i$ that can be carried on this cross-sectional area per inch at the value $\bar{\sigma}_f$ given by the charts may then be compared with the design value of $P_i$.

The value of $\bar{\sigma}_f$ obtained from the design charts can be achieved only if the panels are riveted with large-diameter closely spaced rivets that have essentially the same strength characteristics as the A17S-T4 aluminum-alloy rivets used for the test specimens of references 5 and 6. Reference 8, which presents curves for determining the rivet diameter and pitch required to insure the development of a given average

stress for local instability, may be used as a guide for determining the effect of variations in riveting. Whereas the data of reference 8 are for A17S-T4 flat-head rivets (AN442AD), references 9 and 10 show that the NACA flush rivet, which was used for the hat-stiffened panels, compares very favorably in strength with a flat- or round-head rivet.

## ILLUSTRATIVE EXAMPLES

In order to illustrate the use of the direct-reading design charts and the simplicity of the computations associated with them, two panels are designed from them. The first panel design illustrates the simple case for which interpolation is not a problem. The second design illustrates possible difficulties in interpolation which may be encountered.

First example (interpolation straightforward).- For the first example a panel is designed for minimum weight to meet the following principal design conditions, namely:

(1) Intensity of loading $P_i = 4.0$ kips per inch

(2) Skin thickness $t_S = 0.064$ inch

(3) Effective length $\frac{L}{\sqrt{c}} = 20$ inches

First the values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ are calculated as follows:

$$\frac{P_i}{t_S} = \frac{4.0}{0.064} = 62.5 \text{ ksi}$$

$$\frac{P_i}{L/\sqrt{c}} = \frac{4.0}{20} = 0.20 \text{ ksi}$$

Then a trial value of stiffener thickness to skin thickness $t_W/t_S$ is assumed. If desired, figure 16 may be used to aid in the selection of a suitable ratio of stiffener thickness to skin thickness. For the example, however, in order to illustrate the use of the charts when a nonoptimum thickness ratio is chosen, $\frac{t_W}{t_S} = 1.25$ is used. In the

chart for this value of $t_W/t_S$ (fig. 7), the points corresponding to the design values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ lie in the red region at $\frac{H}{t_W} = 20$ $\left(\text{or } \frac{b_W}{t_W} = 19\right)$. Accordingly, the value of $H/t_W$ for minimum weight for $\frac{t_W}{t_S} = 1.25$ is 20, and because the value is established by a red region, not a blue one, some value of $t_W/t_S$ other than 1.25 will give less weight.

Inspection of the charts for other values of $t_W/t_S$ reveals that the points for the given design values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ fall on a blue line at $\frac{H}{t_W} = 30$ on the chart for $\frac{t_W}{t_S} = 0.79$ (fig. 5). The panel proportions corresponding to this blue line are $\frac{H}{t_W} = 30$ $\left(\text{or } \frac{b_W}{t_W} = 29\right)$ and $\frac{S}{t_S} \approx 32.5$ $\left(\text{or } \frac{b_S}{t_S} \approx 34\right)$, and for these proportions $\bar{\sigma}_f \approx 30.5$ ksi and $\sigma_{cr} \approx 26$ ksi, which are the values for minimum weight. The actual panel dimensions can be calculated from these proportions as

$$t_W = \frac{t_W}{t_S} t_S$$

$$= 0.79 \times 0.064 = 0.051 \text{ in.}$$

$$H = \frac{H}{t_W} t_W$$

$$= 30 \times 0.051 = 1.53 \text{ in.}$$

$$S = \frac{S}{t_S} t_S$$

$$= 32.5 \times 0.064 = 2.08 \text{ in.}$$

and the section properties can be determined from table 5 as

$$\bar{h} = \frac{\bar{h}}{t_S} t_S$$

$$= 6.21 \times 0.064 = 0.397 \text{ in.}$$

$$\rho = \frac{\rho}{t_S} t_S$$

$$= 8.58 \times 0.064 = 0.549 \text{ in.}$$

As a check on the accuracy of interpolation, the magnitude of $\bar{t}/t_S$ for these proportions can be determined from table 5 and multiplied by the values of $t_S$ and $\bar{\sigma}_f$ for the design. This product should be equal to the design value of $P_i$. For the example

$$\bar{\sigma}_f = 30.5 \text{ ksi}$$

$$\frac{\bar{t}}{t_S} = 2.05$$

therefore

$$P_i = \bar{\sigma}_f \bar{t}$$

$$= \bar{\sigma}_f \frac{\bar{t}}{t_S} t_S$$

$$= 30.5 \times 2.05 \times 0.064 = 4.0 \text{ kips/in.}$$

which agrees with the design value of $P_i$ originally assumed.

Second example (interpretation of interpolation difficult).- Because of the wide range of proportions covered in this panel program, each figure in the design charts must also cover a wide range of proportions. Because an increase in the size of the charts over that previously used

did not seem desirable, the change in proportions from plot to plot within the charts was increased; consequently, interpolation has to be made within wider gaps and hence is less straightforward. Moreover, the position of the blue and red regions shifts considerably from plot to plot to correspond to the substantial change in proportions, and, therefore, interpolation to determine the region in which the minimum-weight design lies also may be difficult in some cases.

Possible difficulties of interpolation and a typical solution are demonstrated by the following example. Assume that a panel design for minimum weight is required to meet these design conditions, namely:

(1) $P_i = 3.0$ kips per inch

(2) $t_S = 0.051$ inch

(3) $\frac{L}{\sqrt{c}} = 18$ inches

From these design conditions, values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ may be calculated as follows:

$$\frac{P_i}{t_S} = \frac{3.0}{0.051} = 58.8 \text{ ksi}$$

$$\frac{P_i}{L/\sqrt{c}} = \frac{3.0}{18} = 0.167 \text{ ksi}$$

The point on the summary plot (fig. 16) corresponding to these values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ appears by visual interpolation to fall on the boundary between the regions for which values of $t_W/t_S$ of 0.79 and 1.00 are most efficient. Accordingly, both figures 5 and 6 for values of $t_W/t_S$ of 0.79 and 1.00, respectively, will be used in order to find which one yields the lighter design.

In figure 5, the points corresponding to the design values of $P_i/t_S$ and $\frac{P_i}{L/\sqrt{c}}$ lie above a blue line at $\frac{H}{t_W} = 30$ and below a red

line at $\frac{H}{t_W} = 40$. In figure 6, the corresponding points are above a red line at $\frac{H}{t_W} = 25$ and below a blue line at $\frac{H}{t_W} = 30$. An interpolated value for $\frac{t_W}{t_S} = 0.79$ might have the following proportions

$$\frac{H}{t_W} = 32$$

$$\frac{b_S}{t_S} = 36$$

and develop a stress $\bar{\sigma}_f = 29$ ksi. Corresponding values for $\frac{t_W}{t_S} = 1.00$ might be

$$\frac{H}{t_W} = 26$$

$$\frac{b_S}{t_S} = 54$$

and

$$\bar{\sigma}_f = 29 \text{ ksi}$$

As might be deduced from the fact that the charts do not indicate an advantage for either a thickness ratio of 0.79 or 1.00, there is little difference in the stress that can be carried for $\frac{t_W}{t_S} = 0.79$ or 1.00. In fact, the difference is smaller than can be detected accurately by visual interpolation. The accuracy of interpolation can be improved by making a plot of $H/t_W$ and $\bar{\sigma}_f$ against $S/t_S$ as has been done for this example in figure 17. From this plot, the minimum-weight design conditions corresponding to the maximums of the curves of $\bar{\sigma}_f$ plotted against $S/t_S$ for $\frac{t_W}{t_S} = 0.79$ are found to be

$$\frac{H}{t_W} = 30.8 \quad \left(\text{or} \quad \frac{b_W}{t_W} = 29.8\right)$$

$$\frac{S}{t_S} = 33.6 \quad \left(\text{or} \quad \frac{b_S}{t_S} = 36\right)$$

$$\bar{\sigma}_f = 29.2 \text{ ksi}$$

and

$$\sigma_{cr} = 24.8 \text{ ksi}$$

The panel dimensions can be calculated from these proportions as

$$t_W = \frac{t_W}{t_S} t_S$$

$$= 0.79 \times 0.051 = 0.040 \text{ in.}$$

$$H = \frac{H}{t_W} t_W$$

$$= 30.8 \times 0.040 = 1.23 \text{ in.}$$

$$S = \frac{S}{t_S} t_S$$

$$= 33.6 \times 0.051 = 1.71 \text{ in.}$$

and the section properties are

$$\bar{h} = \frac{\bar{h}}{t_S} t_S$$

$$= 6.35 \times 0.051 = 0.324 \text{ in.}$$

$$\rho = \frac{\rho}{t_S} t_S$$

$$= 8.81 \times 0.051 = 0.450 \text{ in.}$$

As a check on the accuracy of interpolation, the same procedure as followed in the previous section may be used; that is,

$$P_i = \bar{\sigma}_f \bar{t}$$

$$= \bar{\sigma}_f \frac{\bar{t}}{t_S} t_S$$

$$= 29.2 \times 2.02 \times 0.051 = 3.0 \text{ kips/in.}$$

For $\dfrac{t_W}{t_S} = 1.00$, the minimum-weight design conditions are

$$\frac{H}{t_W} = 25.6 \quad \left(\text{or } \frac{b_W}{t_W} = 24.6\right)$$

$$\frac{S}{t_S} = 45 \quad \left(\text{or } \frac{b_S}{t_S} = 55.4\right)$$

$$\bar{\sigma}_f = 28.6 \text{ ksi}$$

and

$$\sigma_{cr} = 18.3 \text{ ksi}$$

Thus

$$t_W = \frac{t_W}{t_S} t_S$$

$$= 1.00 \times 0.051 = 0.051 \text{ in.}$$

$$H = \frac{H}{t_W} t_W$$

$$= 25.6 \times 0.051 = 1.30 \text{ in.}$$

$$S = \frac{S}{t_S} t_S$$

$$= 45 \times 0.051 = 2.29 \text{ in.}$$

The section properties are

$$\bar{h} = \frac{\bar{h}}{t_S} t_S$$

$$= 6.94 \times 0.051 = 0.354 \text{ in.}$$

$$\rho = \frac{\rho}{t_S} t_S$$

$$= 9.58 \times 0.051 = 0.489 \text{ in.}$$

As a check,

$$P_i = \bar{\sigma}_f \bar{t}$$

$$= \bar{\sigma}_f \frac{\bar{t}}{t_S} t_S$$

$$= 28.6 \times 2.05 \times 0.051 = 3.0 \text{ kips/in.}$$

## COMPARISONS OF HAT- AND Z-STIFFENED PANELS

Simple compression.- Previous comparisons (refs. 4 and 5) have made the characteristics of the hat-stiffened panel appear disappointing relative to the Z-stiffened panel despite the inherent stability of the hat-stiffened panel against twisting. For straight compression, the twisting of the Z-~~stiffened panel~~ section stiffener did not seem to be as serious as the typically twisted appearance of failed specimens (fig. 18) would suggest. Although the Z-~~stiffened panel~~ section stiffener always does twist as failure occurs, even when its proportions are definitely such that failure is precipitated by some mode of distortion other than twisting, the twisted appearance of failed specimens was evidently misleading. The indications were that, for a much wider range of proportions than had been realized (including those which are structurally efficient), destructive twisting of the Z-~~stiffened panel~~ section stiffener really occurs only after the maximum load has been reached.

The failure of the hat-stiffened panel to be structurally superior to the Z-stiffened panel at low values of the parameter $P_i/t_S$ (see fig. 16) can readily be accounted for by the fact that at low values of $P_i/t_S$ — that is, at relatively large values of $t_S$ which must be accompanied by wide stiffener spacings — only stiffeners like Z-sections having one rivet line per stiffener can readily be spaced to support the sheet at equal intervals. On the other hand, the reason why there are not at least some proportions for which hat-stiffened panels are more efficient in compression than Z-stiffened panels cannot so readily be explained, even if twisting of the Z-~~stiffened panel~~ section stiffener is not serious - specifically, proportions for which hat-stiffened panels can be made from Z-stiffened panels by turning every other Z-~~stiffened panel~~ section stiffener around and joining the outstanding flanges together so that the sheet is left supported at equal intervals. If the hat section is considered to buckle as a rectangular tube buckles, it should buckle at a higher stress than the Z- or channel section which is one-half the rectangular tube. For example, the coefficient $k$ in the plate-buckling formula for a rectangular tube 0.8 as wide as it is high is given in reference 11 as approximately 4.63; whereas the k-value for a Z-section with a flange-to-web-width ratio of 0.4 is given as only 3.74. In the high-stress region of close stiffener spacings where buckling and failure coincide, therefore, the hat section should be superior to the Z-section. Because the tests reported in references 4 to 6 did not cover hat-stiffened panels having such close stiffener spacings and because the details of construction used for the hat-stiffened panels of those references may have been unfavorable to the hat-stiffened panel, the precisely equivalent hat- and Z-stiffened panels shown in figure 19 were constructed and tested in order to

investigate this possible superiority of closely spaced hat sections. Details of construction of the Z-stiffened panels were the same as those of the panels of reference 2 and were identical with the details of construction (bend radii, widths of attachment flanges, and riveting) of the corresponding six hat-stiffened panels. The proportions were chosen in order to achieve relatively high stresses and relatively high structural efficiencies. $\left(\text{At values of } \dfrac{P_i}{L/\sqrt{c}}\right.$ of 0.12 and 0.30 ksi, respectively, the charts of reference 2 indicate that there are no more efficient 24S-T3 aluminum-alloy Z-stiffened panel cross sections than the two investigated.)

The twelve comparative hat- and Z-stiffened panels were compressed flat-ended in the same manner as in other NACA panel tests. The results are given in table 8(a).

The data of table 8(a) show that the hat-stiffened panels were at best 11 to 13 percent stronger than the equivalent Z-stiffened panels. In other words, for the proportions for which the hat-section panel appears best suited — that is, for those proportions for which the sheet is supported at equal close intervals so that high stresses are achieved — the hat-stiffened panel is somewhat superior structurally to the Z-stiffened panel for carrying simple compression.

Combined compression and bending.- Questions have arisen as to whether, when the stiffened panel is used as the cover of a box beam subjected to shear and bending combined with compression, the twisting of the Z-section does not become more serious than in simple compression. Hat-stiffened panels have been used in some cases in preference to Z-stiffened panels simply because of uncertainty about the twisting of the Z-section under such conditions of combined loads. Actually, the effect of such bending superposed on compression is to some extent covered by the data already published on which the design charts of references 12 and 13 are based. The test panels from which these data were obtained always bent toward the skin as the compressive load was increased because of initial bow induced by the rivets which expanded the skin as they were driven. At the center of the panel where there is a maximum of twisting this initial bow induced a compressive stress in the outstanding flanges of the Z-sections which was higher than the average stress on the cross section. At the center of a Z-stiffened panel in the compression surface of the wing, the stress in the outstanding flanges tends to be: (1) reduced below the average stress on the cross section because the flanges are nearer the neutral axis of the wing than the centroidal axis of the panel cross section and (2) increased above the average stress on the cross section by the bending between ribs caused by the local air loads. For example, if the design illustrative of the use of the charts of reference 12 was located in the upper surface of a wing having its neutral axis 6 inches

from the centroidal axis of the panel and the local air load was 5 psi, the stress in the outstanding flanges in the center of the panel would be: (1) reduced by not more than 5.1 ksi by the proximity of the flanges to the neutral axis of the wing and (2) increased by approximately 5.7 ksi by the local-air-load bending. The resulting slight increase in stress is similar to that caused by the initial bow in the test specimens and appears unlikely to cause much more severe twisting of the Z-sections than occurred in the compressive tests. The best comparable hat-panel design for this example is far removed from the proportions for which the sheet is supported at equal close intervals. Accordingly, here the hat section is inefficient, as indicated in figure 15 which shows that, at the design values of $\frac{P_i}{t_S} = 47$ ksi and $\frac{P_i}{L/\sqrt{c}} = 0.15$ ksi, the hat-stiffened panel can at best achieve a stress 10 percent below the value of 30.5 ksi indicated by figure 19 of reference 7 to be achievable by a Z-stiffened panel. Hence, twisting has to be appreciably more serious than that found in compression before the hat-stiffened panel can become more efficient than the Z-stiffened panel, at least for the conditions of the example and for similar conditions encountered in practice.

In order to study more thoroughly the effect of bending combined with compression, the box beams shown in figure 20 were constructed and tested. The compression covers of these beams were made up of equivalent hat- and Z-stiffened panels of the same cross sections as those used for the previous compressive comparison. The boxes were tested in combined bending and compression in the combined load testing machine of the Langley structures research laboratory with the compression covers bearing flat-ended against the testing machine platens as in previous compression tests and the ratio of bending moment to compression maintained to keep the distance from the centroid of the panel cross section to the neutral axis of the beam between 1 and 1.5 times the stiffener height. The lengths of the boxes were the same as the lengths of the longest compression specimens of table 8(a). The results of the box-beam bending tests are given in table 8(b).

The stresses at the centroids of the panel cross sections at the maximum loads carried in the box-beam bending tests, as calculated by the $\frac{Mc}{I}$-formula and confirmed by strain-gage measurements, were within ±9 percent of the corresponding values obtained in the compression tests. There was no evidence that the Z-section was made less efficient by the bending combined with the compression; in fact, the Z-stiffened panels were relatively better, compared with the hat-stiffened panels in these bending tests, than they were in simple compression.

<u>Combined compression, bending, and shear</u>.- The effects of vertical shear combined with bending and compression on a box beam with a stiffened

panel used as the cover are more complicated to investigate than simple bending and compression alone because the stress in the panel varies along its length and the effect of the gradient of the stress must be considered along with the effect of the shear. Four additional boxes, duplicates of those tested in bending, were tested in bending plus vertical shear to make the stress gradient such that the stresses at one end of the beam were 25 percent higher than those at the other end of the beam. The results are given in table 8(c). The maximum stresses at the panel centroids at maximum load were in every case in excess of those for the pure bending case. The Z-stiffened panels as compared with the hat-stiffened panels were even better under the combined loads than in simple bending.

Loading conditions and stiffener configurations not yet considered.- The effects of local air load and torsion on the box of which the stiffened panel is the cover are still to be evaluated experimentally. No clear reason is evident at present why the local air load should be more harmful to either the hat- or the Z-stiffened panels. For torsion, the hat section would appear to have advantages over the Z-section because of the ability of the hat section to relieve some of the shear stress in the skin underneath it. Whether these advantages would be significant would depend upon the ability of the sheet between the hat section to carry the shear, thus, the hat-stiffened panel would appear best suited for applications involving close stiffener spacings.

When the spaces between hat sections are appreciably greater than those under the hat sections - as they are more likely to be the thicker skinned the construction - the hat section is at a disadvantage relative to the Z-section because the Z-sections can be spaced on the skin at equal intervals. This inherent advantage of the Z-stiffened panel has been noted in previous structural-efficiency comparisons (refs. 4 and 5), and the present box-beam tests have produced no evidence to show that the advantage will disappear when the Z-stiffened panel is used as the cover of such a beam subjected to bending or to bending plus vertical shear rather than to simple compression.

## CONCLUDING REMARKS

Structural evaluations of hat-section stiffeners, together with the direct-reading charts presented herewith for designing hat-stiffened panels, have indicated that the hat-section stiffener is structurally better than the Z-section stiffener for only a limited range of applications at best. For carrying simple compression, and when used as the covers of box beams which are subjected to compression plus bending or to compression plus bending plus vertical shear, the Z-stiffened panel

compared very favorably with the hat-stiffened panel, even in the range of close stiffener spacings for which the hat section is best suited.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., May 20, 1952.

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TABLE 1.- TYPICAL MATERIAL PROPERTIES OF 24S-T3 ALUMINUM-ALLOY

PANELS HAVING FORMED HAT-SECTION STIFFENERS ON

WHICH DESIGN CHARTS ARE BASED

| | Material properties | |
|---|---|---|
| | Aluminum alloy | $\sigma_{cy}$, ksi |
| Sheet | 24S-T3 bare | 43.8 |
| Stiffeners | 24S-T3 bare sheet before forming | 44.3 |

TABLE 2.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.40;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 20.75;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 20.25;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 1.84;\ \frac{p}{t_S} = 9.80\right]$

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | $\frac{\bar{t}}{t_S}$ | 1.384 | 1.401 | 1.418 | 1.426 | 1.434 | 1.450 | 1.466 | 1.480 | 1.495 | 1.509 | 1.523 | 1.536 | 1.548 | 1.561 | 1.573 | 1.585 | 1.596 | 1.607 | 1.618 | 1.629 | 1.639 | 1.649 |
| 24 | | 1.373 | 1.391 | 1.407 | 1.415 | 1.423 | 1.439 | 1.454 | 1.469 | 1.483 | 1.497 | 1.510 | 1.524 | 1.536 | 1.549 | 1.561 | 1.572 | 1.584 | 1.595 | 1.605 | 1.616 | 1.626 | 1.636 |
| 25 | | 1.364 | 1.381 | 1.397 | 1.405 | 1.413 | 1.428 | 1.443 | 1.458 | 1.472 | 1.486 | 1.499 | 1.512 | 1.525 | 1.537 | 1.549 | 1.560 | 1.572 | 1.579 | 1.593 | 1.604 | 1.614 | 1.624 |
| 26 | | 1.355 | 1.371 | 1.387 | 1.395 | 1.403 | 1.418 | 1.433 | 1.447 | 1.461 | 1.475 | 1.488 | 1.501 | 1.513 | 1.525 | 1.537 | 1.549 | 1.560 | 1.571 | 1.581 | 1.592 | 1.602 | 1.612 |
| 27 | | 1.346 | 1.362 | 1.378 | 1.386 | 1.394 | 1.409 | 1.423 | 1.437 | 1.451 | 1.465 | 1.478 | 1.490 | 1.501 | 1.515 | 1.526 | 1.538 | 1.549 | 1.560 | 1.570 | 1.581 | 1.591 | 1.600 |
| 28 | | 1.338 | 1.354 | 1.369 | 1.377 | 1.385 | 1.400 | 1.414 | 1.428 | 1.441 | 1.455 | 1.467 | 1.480 | 1.492 | 1.504 | 1.516 | 1.527 | 1.538 | 1.549 | 1.558 | 1.570 | 1.580 | 1.589 |
| 29 | | 1.330 | 1.346 | 1.361 | 1.369 | 1.376 | 1.391 | 1.405 | 1.419 | 1.432 | 1.444 | 1.458 | 1.470 | 1.482 | 1.494 | 1.506 | 1.517 | 1.528 | 1.538 | 1.548 | 1.559 | 1.567 | 1.579 |
| 30 | | 1.322 | 1.338 | 1.353 | 1.361 | 1.368 | 1.382 | 1.396 | 1.408 | 1.423 | 1.436 | 1.449 | 1.461 | 1.473 | 1.484 | 1.496 | 1.507 | 1.518 | 1.528 | 1.539 | 1.549 | 1.559 | 1.568 |
| 31 | | 1.315 | 1.331 | 1.345 | 1.353 | 1.360 | 1.374 | 1.388 | 1.401 | 1.414 | 1.427 | 1.440 | 1.452 | 1.464 | 1.475 | 1.487 | 1.498 | 1.508 | 1.519 | 1.529 | 1.539 | 1.549 | 1.559 |
| 32 | | 1.308 | 1.323 | 1.338 | 1.345 | 1.352 | 1.366 | 1.380 | 1.397 | 1.406 | 1.419 | 1.431 | 1.443 | 1.455 | 1.466 | 1.477 | 1.488 | 1.499 | 1.510 | 1.520 | 1.530 | 1.539 | 1.549 |
| 33 | | 1.302 | 1.317 | 1.331 | 1.338 | 1.345 | 1.359 | 1.372 | 1.386 | 1.398 | 1.411 | 1.423 | 1.435 | 1.446 | 1.458 | 1.469 | 1.480 | 1.490 | 1.501 | 1.511 | 1.521 | 1.530 | 1.540 |
| 34 | | 1.295 | 1.310 | 1.324 | 1.331 | 1.338 | 1.352 | 1.365 | 1.378 | 1.391 | 1.403 | 1.415 | 1.427 | 1.438 | 1.449 | 1.460 | 1.471 | 1.482 | 1.492 | 1.502 | 1.512 | 1.521 | 1.531 |
| 35 | | 1.289 | 1.304 | 1.322 | 1.325 | 1.332 | 1.345 | 1.358 | 1.371 | 1.386 | 1.396 | 1.407 | 1.419 | 1.430 | 1.441 | 1.452 | 1.463 | 1.473 | 1.484 | 1.494 | 1.503 | 1.513 | 1.522 |
| 36 | | 1.284 | 1.298 | 1.312 | 1.318 | 1.325 | 1.338 | 1.351 | 1.364 | 1.376 | 1.388 | 1.400 | 1.412 | 1.443 | 1.434 | 1.445 | 1.455 | 1.465 | 1.475 | 1.485 | 1.495 | 1.505 | 1.514 |
| 37 | | 1.278 | 1.292 | 1.306 | 1.312 | 1.319 | 1.332 | 1.345 | 1.357 | 1.369 | 1.381 | 1.393 | 1.404 | 1.415 | 1.426 | 1.437 | 1.447 | 1.458 | 1.468 | 1.477 | 1.487 | 1.496 | 1.506 |
| 38 | | 1.273 | 1.286 | 1.300 | 1.306 | 1.313 | 1.326 | 1.339 | 1.351 | 1.363 | 1.375 | 1.386 | 1.397 | 1.408 | 1.418 | 1.430 | 1.440 | 1.460 | 1.460 | 1.470 | 1.479 | 1.489 | 1.498 |
| 39 | | 1.267 | 1.281 | 1.294 | 1.301 | 1.307 | 1.320 | 1.333 | 1.345 | 1.357 | 1.368 | 1.380 | 1.391 | 1.402 | 1.412 | 1.423 | 1.433 | 1.443 | 1.452 | 1.462 | 1.472 | 1.481 | 1.490 |
| 40 | | 1.262 | 1.276 | 1.289 | 1.295 | 1.302 | 1.314 | 1.327 | 1.339 | 1.350 | 1.362 | 1.373 | 1.384 | 1.395 | 1.406 | 1.416 | 1.426 | 1.436 | 1.446 | 1.455 | 1.465 | 1.474 | 1.483 |
| 42 | | 1.253 | 1.266 | 1.279 | 1.285 | 1.291 | 1.304 | 1.316 | 1.327 | 1.339 | 1.350 | 1.361 | 1.372 | 1.382 | 1.392 | 1.403 | 1.413 | 1.423 | 1.432 | 1.442 | 1.451 | 1.460 | 1.469 |
| 44 | | 1.244 | 1.257 | 1.269 | 1.276 | 1.282 | 1.294 | 1.305 | 1.317 | 1.328 | 1.339 | 1.350 | 1.360 | 1.371 | 1.381 | 1.391 | 1.400 | 1.410 | 1.419 | 1.429 | 1.438 | 1.447 | 1.455 |
| 46 | | 1.236 | 1.249 | 1.261 | 1.267 | 1.273 | 1.284 | 1.296 | 1.307 | 1.318 | 1.328 | 1.339 | 1.349 | 1.359 | 1.369 | 1.379 | 1.389 | 1.398 | 1.407 | 1.417 | 1.425 | 1.434 | 1.443 |
| 48 | | 1.229 | 1.241 | 1.252 | 1.258 | 1.264 | 1.275 | 1.286 | 1.297 | 1.308 | 1.319 | 1.329 | 1.339 | 1.349 | 1.359 | 1.361 | 1.378 | 1.387 | 1.396 | 1.405 | 1.414 | 1.422 | 1.431 |
| 50 | | 1.221 | 1.233 | 1.245 | 1.250 | 1.256 | 1.267 | 1.278 | 1.289 | 1.299 | 1.314 | 1.319 | 1.329 | 1.338 | 1.349 | 1.361 | 1.367 | 1.376 | 1.385 | 1.394 | 1.403 | 1.411 | 1.420 |
| 52 | | 1.215 | 1.226 | 1.237 | 1.243 | 1.248 | 1.259 | 1.270 | 1.280 | 1.291 | 1.301 | 1.311 | 1.320 | 1.330 | 1.339 | 1.348 | 1.358 | 1.366 | 1.375 | 1.384 | 1.392 | 1.401 | 1.409 |
| 54 | | 1.208 | 1.219 | 1.230 | 1.236 | 1.244 | 1.252 | 1.262 | 1.272 | 1.282 | 1.292 | 1.302 | 1.312 | 1.321 | 1.330 | 1.339 | 1.348 | 1.357 | 1.366 | 1.374 | 1.382 | 1.391 | 1.399 |
| 56 | | 1.202 | 1.213 | 1.224 | 1.229 | 1.235 | 1.245 | 1.255 | 1.265 | 1.275 | 1.285 | 1.294 | 1.303 | 1.314 | 1.322 | 1.331 | 1.339 | 1.348 | 1.356 | 1.365 | 1.373 | 1.381 | 1.389 |
| 58 | | 1.197 | 1.207 | 1.218 | 1.223 | 1.228 | 1.238 | 1.248 | 1.258 | 1.268 | 1.277 | 1.286 | 1.296 | 1.305 | 1.314 | 1.322 | 1.331 | 1.339 | 1.348 | 1.356 | 1.364 | 1.372 | 1.380 |
| 60 | | 1.191 | 1.202 | 1.212 | 1.217 | 1.222 | 1.232 | 1.242 | 1.251 | 1.261 | 1.270 | 1.279 | 1.288 | 1.297 | 1.306 | 1.314 | 1.323 | 1.331 | 1.339 | 1.348 | 1.355 | 1.363 | 1.371 |
| 63 | | 1.184 | 1.194 | 1.204 | 1.209 | 1.212 | 1.223 | 1.233 | 1.242 | 1.251 | 1.260 | 1.269 | 1.278 | 1.286 | 1.295 | 1.303 | 1.321 | 1.320 | 1.328 | 1.336 | 1.343 | 1.351 | 1.359 |
| 66 | | 1.177 | 1.187 | 1.196 | 1.201 | 1.206 | 1.215 | 1.224 | 1.233 | 1.242 | 1.251 | 1.260 | 1.268 | 1.277 | 1.285 | 1.293 | 1.301 | 1.309 | 1.317 | 1.324 | 1.332 | 1.340 | 1.347 |
| 69 | | 1.171 | 1.180 | 1.189 | 1.194 | 1.199 | 1.208 | 1.216 | 1.225 | 1.234 | 1.242 | 1.251 | 1.259 | 1.267 | 1.275 | 1.283 | 1.291 | 1.299 | 1.307 | 1.314 | 1.321 | 1.329 | 1.336 |
| 72 | | 1.165 | 1.174 | 1.183 | 1.187 | 1.192 | 1.201 | 1.209 | 1.218 | 1.226 | 1.234 | 1.243 | 1.251 | 1.259 | 1.267 | 1.274 | 1.282 | 1.289 | 1.297 | 1.304 | 1.312 | 1.319 | 1.326 |
| 75 | | 1.159 | 1.168 | 1.177 | 1.181 | 1.185 | 1.194 | 1.202 | 1.211 | 1.219 | 1.227 | 1.235 | 1.243 | 1.251 | 1.258 | 1.266 | 1.273 | 1.281 | 1.288 | 1.295 | 1.302 | 1.309 | 1.316 |
| 78 | | 1.154 | 1.163 | 1.171 | 1.175 | 1.179 | 1.188 | 1.196 | 1.204 | 1.212 | 1.220 | 1.228 | 1.235 | 1.242 | 1.250 | 1.258 | 1.265 | 1.272 | 1.279 | 1.286 | 1.293 | 1.300 | 1.307 |
| 81 | | 1.149 | 1.157 | 1.166 | 1.170 | 1.174 | 1.182 | 1.190 | 1.198 | 1.206 | 1.213 | 1.221 | 1.228 | 1.236 | 1.243 | 1.250 | 1.257 | 1.264 | 1.271 | 1.278 | 1.285 | 1.292 | 1.298 |
| 84 | | 1.144 | 1.153 | 1.161 | 1.165 | 1.169 | 1.177 | 1.184 | 1.192 | 1.200 | 1.207 | 1.214 | 1.222 | 1.229 | 1.236 | 1.243 | 1.250 | 1.257 | 1.264 | 1.271 | 1.277 | 1.284 | 1.290 |
| 23 | $\frac{\bar{h}}{t_S}$ | 1.491 | 1.584 | 1.745 | 1.828 | 1.913 | 2.089 | 2.272 | 2.460 | 2.654 | 2.854 | 3.058 | 3.267 | 3.480 | 3.697 | 3.917 | 4.141 | 4.369 | 4.599 | 4.832 | 5.068 | 5.307 | 5.547 |
| 24 | | 1.413 | 1.564 | 1.722 | 1.804 | 1.888 | 2.062 | 2.242 | 2.428 | 2.620 | 2.817 | 3.019 | 3.226 | 3.437 | 3.651 | 3.870 | 4.091 | 4.317 | 4.545 | 4.777 | 5.010 | 5.247 | 5.861 |
| 25 | | 1.396 | 1.544 | 1.700 | 1.781 | 1.864 | 2.035 | 2.213 | 2.397 | 2.587 | 2.782 | 2.981 | 3.186 | 3.394 | 3.607 | 3.823 | 4.043 | 4.267 | 4.502 | 4.722 | 4.954 | 5.189 | 5.426 |
| 26 | | 1.380 | 1.525 | 1.679 | 1.759 | 1.844 | 2.010 | 2.186 | 2.367 | 2.554 | 2.747 | 2.945 | 3.147 | 3.353 | 3.564 | 3.778 | 3.996 | 4.218 | 4.442 | 4.670 | 4.900 | 5.133 | 5.368 |
| 27 | | 1.364 | 1.507 | 1.659 | 1.738 | 1.818 | 1.985 | 2.159 | 2.338 | 2.523 | 2.714 | 2.909 | 3.109 | 3.308 | 3.522 | 3.735 | 3.950 | 4.170 | 4.392 | 4.618 | 4.846 | 5.077 | 5.311 |
| 28 | | 1.348 | 1.489 | 1.639 | 1.717 | 1.797 | 1.961 | 2.132 | 2.310 | 2.493 | 2.681 | 2.874 | 3.072 | 3.275 | 3.481 | 3.692 | 3.906 | 4.123 | 4.344 | 4.568 | 4.794 | 5.024 | 5.255 |
| 29 | | 1.333 | 1.473 | 1.620 | 1.697 | 1.776 | 1.938 | 2.107 | 2.282 | 2.463 | 2.650 | 2.841 | 3.037 | 3.237 | 3.442 | 3.650 | 3.862 | 4.078 | 4.297 | 4.518 | 4.743 | 4.971 | 5.201 |
| 30 | | 1.319 | 1.456 | 1.602 | 1.678 | 1.755 | 1.916 | 2.083 | 2.256 | 2.435 | 2.619 | 2.808 | 3.002 | 3.201 | 3.403 | 3.610 | 3.820 | 4.034 | 4.251 | 4.471 | 4.693 | 4.919 | 5.148 |
| 31 | | 1.305 | 1.440 | 1.584 | 1.659 | 1.735 | 1.894 | 2.059 | 2.230 | 2.407 | 2.589 | 2.776 | 2.969 | 3.165 | 3.366 | 3.570 | 3.778 | 3.990 | 4.206 | 4.424 | 4.645 | 4.869 | 5.096 |
| 32 | | 1.291 | 1.425 | 1.567 | 1.641 | 1.716 | 1.873 | 2.036 | 2.205 | 2.380 | 2.560 | 2.745 | 2.936 | 3.130 | 3.329 | 3.532 | 3.738 | 3.948 | 4.162 | 4.378 | 4.597 | 4.820 | 5.045 |
| 33 | | 1.279 | 1.410 | 1.550 | 1.623 | 1.698 | 1.852 | 2.013 | 2.181 | 2.354 | 2.532 | 2.715 | 2.904 | 3.096 | 3.293 | 3.494 | 3.699 | 3.907 | 4.119 | 4.333 | 4.551 | 4.772 | 4.995 |
| 34 | | 1.266 | 1.396 | 1.534 | 1.606 | 1.680 | 1.832 | 1.992 | 2.157 | 2.328 | 2.505 | 2.686 | 2.873 | 3.063 | 3.258 | 3.458 | 3.660 | 3.867 | 4.077 | 4.290 | 4.506 | 4.725 | 4.947 |
| 35 | | 1.254 | 1.382 | 1.518 | 1.589 | 1.662 | 1.813 | 1.970 | 2.134 | 2.303 | 2.478 | 2.658 | 2.842 | 3.031 | 3.224 | 3.422 | 3.623 | 3.828 | 4.036 | 4.247 | 4.461 | 4.679 | 4.899 |
| 36 | | 1.242 | 1.369 | 1.503 | 1.573 | 1.645 | 1.794 | 1.950 | 2.112 | 2.279 | 2.452 | 2.630 | 2.813 | 3.000 | 3.191 | 3.387 | 3.586 | 3.789 | 3.995 | 4.205 | 4.418 | 4.634 | 4.852 |
| 37 | | 1.231 | 1.356 | 1.489 | 1.558 | 1.629 | 1.776 | 1.930 | 2.090 | 2.256 | 2.427 | 2.603 | 2.784 | 2.969 | 3.159 | 3.353 | 3.550 | 3.750 | 3.957 | 4.165 | 4.376 | 4.590 | 4.807 |
| 38 | | 1.219 | 1.343 | 1.474 | 1.543 | 1.613 | 1.758 | 1.911 | 2.069 | 2.233 | 2.400 | 2.576 | 2.756 | 2.939 | 3.127 | 3.320 | 3.515 | 3.715 | 3.918 | 4.125 | 4.334 | 4.547 | 4.762 |
| 39 | | 1.209 | 1.331 | 1.460 | 1.528 | 1.597 | 1.741 | 1.892 | 2.048 | 2.210 | 2.378 | 2.551 | 2.728 | 2.910 | 3.097 | 3.287 | 3.481 | 3.679 | 3.881 | 4.086 | 4.294 | 4.505 | 4.718 |
| 40 | | 1.198 | 1.319 | 1.447 | 1.513 | 1.582 | 1.724 | 1.873 | 2.028 | 2.189 | 2.354 | 2.525 | 2.701 | 2.882 | 3.069 | 3.255 | 3.448 | 3.644 | 3.844 | 4.048 | 4.264 | 4.463 | 4.676 |

TABLE 2.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.40;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 20.75;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 20.25;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 1.84;\ \frac{p}{t_S} = 9.80\right]$ - Concluded

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | $\frac{\bar{h}}{t_S}$ | 1.178 | 1.296 | 1.421 | 1.486 | 1.553 | 1.692 | 1.838 | 1.989 | 2.147 | 2.309 | 2.477 | 2.650 | 2.827 | 3.008 | 3.194 | 3.383 | 3.577 | 3.773 | 3.974 | 4.177 | 4.383 | 4.592 |
| 44 | | 1.159 | 1.274 | 1.396 | 1.460 | 1.526 | 1.662 | 1.804 | 1.953 | 2.107 | 2.266 | 2.431 | 2.600 | 2.774 | 2.953 | 3.135 | 3.321 | 3.512 | 3.705 | 3.902 | 4.103 | 4.306 | 4.512 |
| 46 | | 1.142 | 1.254 | 1.373 | 1.435 | 1.499 | 1.633 | 1.772 | 1.918 | 2.069 | 2.225 | 2.387 | 2.553 | 2.724 | 2.899 | 3.079 | 3.261 | 3.450 | 3.640 | 3.834 | 4.032 | 4.232 | 4.436 |
| 48 | | 1.125 | 1.234 | 1.351 | 1.412 | 1.475 | 1.605 | 1.742 | 1.884 | 2.033 | 2.186 | 2.345 | 2.508 | 2.677 | 2.848 | 3.040 | 3.205 | 3.390 | 3.578 | 3.769 | 3.963 | 4.161 | 4.362 |
| 50 | | 1.109 | 1.216 | 1.330 | 1.390 | 1.451 | 1.579 | 1.713 | 1.854 | 1.998 | 2.141 | 2.304 | 2.465 | 2.630 | 2.802 | 2.973 | 3.151 | 3.333 | 3.518 | 3.706 | 3.898 | 4.093 | 4.290 |
| 52 | | 1.094 | 1.198 | 1.310 | 1.368 | 1.428 | 1.554 | 1.685 | 1.822 | 1.965 | 2.112 | 2.266 | 2.422 | 2.586 | 2.799 | 2.924 | 3.099 | 3.277 | 3.460 | 3.645 | 3.834 | 4.027 | 4.222 |
| 54 | | 1.079 | 1.181 | 1.291 | 1.348 | 1.417 | 1.530 | 1.659 | 1.793 | 1.833 | 2.079 | 2.229 | 2.384 | 2.544 | 2.708 | 2.876 | 3.048 | 3.224 | 3.404 | 3.587 | 3.773 | 3.963 | 4.156 |
| 56 | | 1.065 | 1.165 | 1.273 | 1.329 | 1.387 | 1.507 | 1.633 | 1.765 | 1.903 | 2.046 | 2.194 | 2.346 | 2.503 | 2.665 | 2.826 | 3.030 | 3.173 | 3.350 | 3.531 | 3.714 | 3.902 | 4.092 |
| 58 | | 1.052 | 1.150 | 1.255 | 1.310 | 1.367 | 1.485 | 1.609 | 1.739 | 1.874 | 2.014 | 2.160 | 2.310 | 2.464 | 2.623 | 2.786 | 2.953 | 3.124 | 3.299 | 3.476 | 3.658 | 3.842 | 4.030 |
| 60 | | 1.040 | 1.136 | 1.239 | 1.293 | 1.348 | 1.464 | 1.586 | 1.713 | 1.846 | 1.984 | 2.127 | 2.275 | 2.427 | 2.583 | 2.744 | 2.908 | 3.077 | 3.249 | 3.424 | 3.603 | 3.785 | 3.970 |
| 63 | | 1.022 | 1.115 | 1.215 | 1.267 | 1.322 | 1.434 | 1.553 | 1.677 | 1.806 | 1.941 | 2.080 | 2.225 | 2.373 | 2.526 | 2.683 | 2.824 | 3.009 | 3.177 | 3.349 | 3.524 | 3.703 | 3.885 |
| 66 | | 1.005 | 1.096 | 1.193 | 1.244 | 1.297 | 1.406 | 1.522 | 1.643 | 1.769 | 1.900 | 2.036 | 2.177 | 2.322 | 2.472 | 2.626 | 2.783 | 2.945 | 3.109 | 3.278 | 3.450 | 3.629 | 3.803 |
| 69 | | .9894 | 1.078 | 1.172 | 1.222 | 1.273 | 1.380 | 1.492 | 1.610 | 1.734 | 1.862 | 1.995 | 2.132 | 2.274 | 2.421 | 2.571 | 2.725 | 2.283 | 3.045 | 3.210 | 3.378 | 3.550 | 3.725 |
| 72 | | .9747 | 1.060 | 1.153 | 1.201 | 1.251 | 1.356 | 1.465 | 1.580 | 1.700 | 1.825 | 1.955 | 2.090 | 2.229 | 2.372 | 2.519 | 2.670 | 2.825 | 2.983 | 3.145 | 3.311 | 3.479 | 3.651 |
| 75 | | .9609 | 1.044 | 1.134 | 1.181 | 1.230 | 1.331 | 1.439 | 1.551 | 1.668 | 1.791 | 1.918 | 2.049 | 2.185 | 2.326 | 2.470 | 2.618 | 2.770 | 2.925 | 3.084 | 3.246 | 3.411 | 3.580 |
| 78 | | .9478 | 1.029 | 1.117 | 1.163 | 1.210 | 1.309 | 1.414 | 1.523 | 1.638 | 1.758 | 1.882 | 2.011 | 2.144 | 2.283 | 2.423 | 2.568 | 2.717 | 2.869 | 3.025 | 3.184 | 3.347 | 3.512 |
| 81 | | .9355 | 1.015 | 1.100 | 1.145 | 1.191 | 1.288 | 1.390 | 1.497 | 1.610 | 1.727 | 1.848 | 1.975 | 2.105 | 2.239 | 2.380 | 2.520 | 2.666 | 2.816 | 2.969 | 3.125 | 3.285 | 3.448 |
| 84 | | .9238 | 1.001 | 1.085 | 1.130 | 1.174 | 1.268 | 1.368 | 1.473 | 1.583 | 1.697 | 1.816 | 1.940 | 2.068 | 2.199 | 2.338 | 2.475 | 2.618 | 2.765 | 2.915 | 3.069 | 3.225 | 3.386 |
| 23 | $\frac{\rho}{t_S}$ | 2.189 | 2.480 | 2.777 | 2.911 | 3.078 | 3.383 | 3.691 | 4.003 | 4.316 | 4.632 | 4.950 | 5.269 | 5.590 | 5.910 | 6.234 | 6.558 | 6.882 | 7.207 | 7.599 | 7.860 | 8.186 | 8.514 |
| 24 | | 2.172 | 2.461 | 2.757 | 2.890 | 3.056 | 3.358 | 3.667 | 3.978 | 4.291 | 4.605 | 4.922 | 5.241 | 5.560 | 5.881 | 6.204 | 6.526 | 6.851 | 7.175 | 7.501 | 7.827 | 8.153 | 8.480 |
| 25 | | 2.155 | 2.443 | 2.737 | 2.870 | 3.035 | 3.338 | 3.644 | 3.953 | 4.265 | 4.578 | 4.894 | 5.212 | 5.531 | 5.852 | 6.174 | 6.496 | 6.819 | 7.148 | 7.468 | 7.794 | 8.149 | 8.446 |
| 26 | | 2.139 | 2.425 | 2.718 | 2.850 | 3.014 | 3.316 | 3.621 | 3.929 | 4.240 | 4.553 | 4.868 | 5.185 | 5.485 | 5.823 | 6.144 | 6.465 | 6.786 | 7.112 | 7.437 | 7.761 | 8.087 | 8.413 |
| 27 | | 2.123 | 2.408 | 2.699 | 2.831 | 2.994 | 3.295 | 3.598 | 3.905 | 4.215 | 4.527 | 4.837 | 5.157 | 5.473 | 5.794 | 6.114 | 6.435 | 6.757 | 7.081 | 7.405 | 7.729 | 8.054 | 8.380 |
| 28 | | 2.107 | 2.391 | 2.680 | 2.812 | 2.975 | 3.273 | 3.576 | 3.882 | 4.191 | 4.501 | 4.815 | 5.130 | 5.447 | 5.765 | 6.085 | 6.406 | 6.727 | 7.050 | 7.373 | 7.697 | 8.022 | 8.348 |
| 29 | | 2.092 | 2.374 | 2.662 | 2.793 | 2.955 | 3.253 | 3.554 | 3.859 | 4.167 | 4.477 | 4.791 | 5.103 | 5.420 | 5.737 | 6.056 | 6.376 | 6.697 | 7.019 | 7.344 | 7.666 | 7.990 | 8.315 |
| 30 | | 2.077 | 2.358 | 2.644 | 2.775 | 2.936 | 3.232 | 3.533 | 3.836 | 4.143 | 4.452 | 4.764 | 5.076 | 5.392 | 5.709 | 6.027 | 6.347 | 6.667 | 6.989 | 7.311 | 7.635 | 7.958 | 8.283 |
| 31 | | 2.063 | 2.341 | 2.627 | 2.757 | 2.917 | 3.212 | 3.511 | 3.814 | 4.120 | 4.428 | 4.738 | 5.051 | 5.365 | 5.682 | 5.999 | 6.318 | 6.638 | 6.959 | 7.281 | 7.604 | 7.927 | 8.269 |
| 32 | | 2.048 | 2.326 | 2.609 | 2.739 | 2.899 | 3.193 | 3.491 | 3.792 | 4.097 | 4.404 | 4.714 | 5.025 | 5.339 | 5.655 | 5.971 | 6.290 | 6.609 | 6.929 | 7.251 | 7.573 | 7.896 | 8.219 |
| 33 | | 2.034 | 2.310 | 2.593 | 2.722 | 2.881 | 3.173 | 3.470 | 3.771 | 4.074 | 4.380 | 4.689 | 5.000 | 5.313 | 5.628 | 5.935 | 6.261 | 6.580 | 6.900 | 7.221 | 7.542 | 7.867 | 8.188 |
| 34 | | 2.020 | 2.295 | 2.576 | 2.705 | 2.863 | 3.154 | 3.450 | 3.749 | 4.052 | 4.357 | 4.665 | 4.975 | 5.287 | 5.601 | 5.917 | 6.233 | 6.550 | 6.871 | 7.191 | 7.512 | 7.834 | 8.157 |
| 35 | | 2.007 | 2.280 | 2.560 | 2.688 | 2.845 | 3.136 | 3.430 | 3.728 | 4.030 | 4.334 | 4.641 | 4.951 | 5.262 | 5.575 | 5.904 | 6.206 | 6.523 | 6.842 | 7.162 | 7.482 | 7.804 | 8.126 |
| 36 | | 1.994 | 2.265 | 2.544 | 2.671 | 2.837 | 3.117 | 3.411 | 3.708 | 4.008 | 4.312 | 4.618 | 4.926 | 5.237 | 5.549 | 5.863 | 6.179 | 6.495 | 6.814 | 7.133 | 7.453 | 7.774 | 8.096 |
| 37 | | 1.981 | 2.251 | 2.528 | 2.655 | 2.811 | 3.099 | 3.392 | 3.688 | 3.987 | 4.290 | 4.595 | 4.902 | 5.212 | 5.524 | 5.837 | 6.144 | 6.467 | 6.786 | 7.104 | 7.423 | 7.744 | 8.065 |
| 38 | | 1.968 | 2.237 | 2.513 | 2.639 | 2.795 | 3.081 | 3.373 | 3.668 | 3.965 | 4.268 | 4.572 | 4.878 | 5.188 | 5.498 | 5.811 | 6.125 | 6.440 | 6.757 | 7.075 | 7.394 | 7.714 | 8.035 |
| 39 | | 1.955 | 2.223 | 2.498 | 2.624 | 2.778 | 3.064 | 3.354 | 3.648 | 3.946 | 4.246 | 4.550 | 4.855 | 5.163 | 5.473 | 5.784 | 6.099 | 6.426 | 6.730 | 7.047 | 7.366 | 7.685 | 8.056 |
| 40 | | 1.943 | 2.210 | 2.483 | 2.608 | 2.762 | 3.047 | 3.336 | 3.629 | 3.925 | 4.225 | 4.527 | 4.832 | 5.139 | 5.405 | 5.760 | 6.073 | 6.387 | 6.702 | 7.019 | 7.337 | 7.656 | 7.976 |
| 42 | | 1.919 | 2.183 | 2.454 | 2.578 | 2.731 | 3.013 | 3.300 | 3.591 | 3.885 | 4.183 | 4.484 | 4.787 | 5.093 | 5.400 | 5.710 | 6.021 | 6.334 | 6.648 | 6.964 | 7.281 | 7.599 | 7.918 |
| 44 | | 1.896 | 2.158 | 2.422 | 2.550 | 2.701 | 2.981 | 3.265 | 3.554 | 3.854 | 4.143 | 4.440 | 4.743 | 5.047 | 5.353 | 5.661 | 5.971 | 6.283 | 6.596 | 6.910 | 7.226 | 7.543 | 7.861 |
| 46 | | 1.874 | 2.133 | 2.399 | 2.522 | 2.671 | 2.949 | 3.231 | 3.518 | 3.809 | 4.103 | 4.400 | 4.700 | 5.002 | 5.307 | 5.614 | 5.923 | 6.232 | 6.544 | 6.857 | 7.153 | 7.488 | 7.844 |
| 48 | | 1.853 | 2.109 | 2.373 | 2.494 | 2.643 | 2.910 | 3.199 | 3.484 | 3.780 | 4.065 | 4.360 | 4.658 | 4.958 | 5.262 | 5.577 | 5.874 | 6.183 | 6.400 | 6.805 | 7.119 | 7.433 | 7.749 |
| 50 | | 1.832 | 2.086 | 2.348 | 2.468 | 2.615 | 2.890 | 3.167 | 3.450 | 3.737 | 4.021 | 4.321 | 4.617 | 4.916 | 5.217 | 5.521 | 5.827 | 6.135 | 6.444 | 6.755 | 7.067 | 7.380 | 7.698 |
| 52 | | 1.812 | 2.064 | 2.323 | 2.443 | 2.589 | 2.860 | 3.136 | 3.417 | 3.712 | 3.991 | 4.281 | 4.578 | 4.875 | 5.159 | 5.477 | 5.781 | 6.087 | 6.395 | 6.705 | 7.016 | 7.328 | 7.642 |
| 54 | | 1.793 | 2.042 | 2.299 | 2.418 | 2.561 | 2.832 | 3.106 | 3.385 | 3.668 | 3.955 | 4.245 | 4.538 | 4.834 | 5.133 | 5.432 | 5.736 | 6.041 | 6.348 | 6.656 | 6.966 | 7.277 | 7.590 |
| 56 | | 1.774 | 2.021 | 2.276 | 2.394 | 2.538 | 2.805 | 3.077 | 3.354 | 3.635 | 3.919 | 4.208 | 4.500 | 4.795 | 5.092 | 5.392 | 5.682 | 5.996 | 6.301 | 6.608 | 6.917 | 7.227 | 7.539 |
| 58 | | 1.756 | 2.001 | 2.254 | 2.371 | 2.514 | 2.781 | 3.049 | 3.324 | 3.603 | 3.887 | 4.173 | 4.460 | 4.756 | 5.051 | 5.349 | 5.649 | 5.948 | 6.256 | 6.562 | 6.869 | 7.178 | 7.488 |
| 60 | | 1.738 | 1.981 | 2.232 | 2.348 | 2.489 | 2.753 | 3.021 | 3.294 | 3.572 | 3.854 | 4.139 | 4.427 | 4.718 | 5.012 | 5.308 | 5.607 | 5.908 | 6.211 | 6.516 | 6.822 | 7.134 | 7.439 |
| 63 | | 1.713 | 1.953 | 2.201 | 2.316 | 2.455 | 2.715 | 2.981 | 3.252 | 3.527 | 3.806 | 4.088 | 4.374 | 4.663 | 4.955 | 5.249 | 5.531 | 5.844 | 6.145 | 6.448 | 6.752 | 7.058 | 7.388 |
| 66 | | 1.689 | 1.926 | 2.170 | 2.284 | 2.425 | 2.680 | 2.943 | 3.211 | 3.483 | 3.759 | 4.040 | 4.323 | 4.610 | 4.899 | 5.191 | 5.486 | 5.783 | 6.082 | 6.383 | 6.685 | 6.988 | 7.295 |
| 69 | | 1.665 | 1.900 | 2.141 | 2.254 | 2.390 | 2.645 | 2.905 | 3.171 | 3.448 | 3.715 | 3.993 | 4.274 | 4.558 | 4.845 | 5.135 | 5.428 | 5.723 | 6.020 | 6.319 | 6.620 | 6.922 | 7.226 |
| 72 | | 1.643 | 1.874 | 2.114 | 2.226 | 2.360 | 2.613 | 2.870 | 3.133 | 3.400 | 3.672 | 3.947 | 4.226 | 4.508 | 4.793 | 5.080 | 5.372 | 5.665 | 5.960 | 6.257 | 6.556 | 6.857 | 7.159 |
| 75 | | 1.622 | 1.850 | 2.087 | 2.197 | 2.330 | 2.580 | 2.835 | 3.096 | 3.361 | 3.630 | 3.905 | 4.180 | 4.460 | 4.743 | 5.029 | 5.317 | 5.608 | 5.901 | 6.197 | 6.494 | 6.793 | 7.094 |
| 78 | | 1.601 | 1.827 | 2.061 | 2.170 | 2.302 | 2.549 | 2.802 | 3.060 | 3.323 | 3.589 | 3.860 | 4.135 | 4.413 | 4.693 | 4.977 | 5.249 | 5.553 | 5.846 | 6.138 | 6.433 | 6.731 | 7.030 |
| 81 | | 1.581 | 1.805 | 2.036 | 2.144 | 2.275 | 2.520 | 2.770 | 3.057 | 3.288 | 3.551 | 3.819 | 4.092 | 4.367 | 4.646 | 4.927 | 5.213 | 5.463 | 5.789 | 6.081 | 6.375 | 6.670 | 6.968 |
| 84 | | 1.562 | 1.783 | 2.012 | 2.119 | 2.248 | 2.491 | 2.739 | 3.024 | 3.244 | 3.513 | 3.379 | 4.049 | 4.323 | 4.600 | 4.879 | 5.163 | 5.448 | 5.735 | 6.025 | 6.317 | 6.611 | 6.907 |

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TABLE 3.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.51;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 19.56;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 19.06;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.14;\ \frac{p}{t_S} = 10.92\right]$

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | $\frac{\bar{t}}{t_S}$ | 1.569 | 1.583 | 1.607 | 1.619 | 1.630 | 1.652 | 1.673 | 1.694 | 1.713 | 1.732 | 1.751 | 1.769 | 1.786 | 1.802 | 1.818 | 1.834 | 1.849 | 1.864 | 1.878 | 1.892 | 1.905 | 1.918 |
| 24 | | 1.545 | 1.569 | 1.593 | 1.604 | 1.615 | 1.637 | 1.658 | 1.678 | 1.698 | 1.717 | 1.735 | 1.753 | 1.770 | 1.787 | 1.803 | 1.818 | 1.833 | 1.848 | 1.862 | 1.876 | 1.889 | 1.902 |
| 25 | | 1.532 | 1.556 | 1.579 | 1.590 | 1.602 | 1.623 | 1.644 | 1.664 | 1.683 | 1.702 | 1.720 | 1.738 | 1.755 | 1.771 | 1.787 | 1.803 | 1.818 | 1.832 | 1.847 | 1.860 | 1.874 | 1.887 |
| 26 | | 1.520 | 1.543 | 1.566 | 1.577 | 1.588 | 1.610 | 1.630 | 1.655 | 1.669 | 1.688 | 1.706 | 1.723 | 1.740 | 1.757 | 1.773 | 1.788 | 1.803 | 1.817 | 1.832 | 1.846 | 1.859 | 1.872 |
| 27 | | 1.508 | 1.531 | 1.554 | 1.565 | 1.576 | 1.597 | 1.617 | 1.637 | 1.656 | 1.674 | 1.692 | 1.709 | 1.726 | 1.751 | 1.758 | 1.774 | 1.789 | 1.803 | 1.817 | 1.831 | 1.844 | 1.857 |
| 28 | | 1.496 | 1.520 | 1.542 | 1.553 | 1.563 | 1.584 | 1.604 | 1.624 | 1.643 | 1.661 | 1.679 | 1.696 | 1.713 | 1.729 | 1.745 | 1.760 | 1.775 | 1.789 | 1.803 | 1.817 | 1.830 | 1.843 |
| 29 | | 1.486 | 1.508 | 1.530 | 1.541 | 1.552 | 1.572 | 1.592 | 1.612 | 1.630 | 1.648 | 1.666 | 1.683 | 1.700 | 1.716 | 1.731 | 1.747 | 1.761 | 1.776 | 1.790 | 1.803 | 1.817 | 1.830 |
| 30 | | 1.475 | 1.498 | 1.520 | 1.530 | 1.541 | 1.561 | 1.581 | 1.600 | 1.618 | 1.636 | 1.654 | 1.671 | 1.687 | 1.703 | 1.719 | 1.734 | 1.749 | 1.763 | 1.777 | 1.790 | 1.804 | 1.816 |
| 31 | | 1.465 | 1.488 | 1.509 | 1.520 | 1.530 | 1.550 | 1.570 | 1.588 | 1.607 | 1.625 | 1.642 | 1.659 | 1.675 | 1.691 | 1.706 | 1.721 | 1.736 | 1.750 | 1.764 | 1.778 | 1.791 | 1.804 |
| 32 | | 1.456 | 1.478 | 1.499 | 1.509 | 1.520 | 1.540 | 1.559 | 1.576 | 1.596 | 1.613 | 1.631 | 1.647 | 1.663 | 1.679 | 1.695 | 1.709 | 1.724 | 1.738 | 1.752 | 1.765 | 1.779 | 1.791 |
| 33 | | 1.447 | 1.468 | 1.489 | 1.500 | 1.510 | 1.529 | 1.548 | 1.567 | 1.585 | 1.602 | 1.620 | 1.636 | 1.652 | 1.668 | 1.683 | 1.698 | 1.712 | 1.726 | 1.740 | 1.754 | 1.767 | 1.779 |
| 34 | | 1.438 | 1.459 | 1.480 | 1.490 | 1.500 | 1.520 | 1.539 | 1.557 | 1.575 | 1.592 | 1.609 | 1.625 | 1.641 | 1.657 | 1.672 | 1.687 | 1.701 | 1.715 | 1.729 | 1.742 | 1.755 | 1.768 |
| 35 | | 1.430 | 1.451 | 1.471 | 1.482 | 1.491 | 1.510 | 1.529 | 1.547 | 1.565 | 1.582 | 1.599 | 1.615 | 1.631 | 1.646 | 1.661 | 1.676 | 1.690 | 1.704 | 1.718 | 1.731 | 1.744 | 1.756 |
| 36 | | 1.422 | 1.442 | 1.462 | 1.472 | 1.482 | 1.501 | 1.520 | 1.538 | 1.555 | 1.572 | 1.589 | 1.605 | 1.621 | 1.636 | 1.651 | 1.665 | 1.679 | 1.693 | 1.707 | 1.720 | 1.733 | 1.745 |
| 37 | | 1.414 | 1.434 | 1.454 | 1.464 | 1.474 | 1.492 | 1.511 | 1.528 | 1.546 | 1.563 | 1.579 | 1.595 | 1.611 | 1.626 | 1.641 | 1.655 | 1.669 | 1.683 | 1.696 | 1.710 | 1.722 | 1.735 |
| 38 | | 1.406 | 1.426 | 1.446 | 1.456 | 1.465 | 1.484 | 1.502 | 1.520 | 1.537 | 1.553 | 1.570 | 1.586 | 1.601 | 1.616 | 1.631 | 1.645 | 1.659 | 1.673 | 1.686 | 1.699 | 1.712 | 1.724 |
| 39 | | 1.399 | 1.419 | 1.438 | 1.448 | 1.457 | 1.476 | 1.494 | 1.511 | 1.528 | 1.545 | 1.561 | 1.576 | 1.592 | 1.606 | 1.621 | 1.636 | 1.650 | 1.663 | 1.676 | 1.689 | 1.702 | 1.714 |
| 40 | | 1.392 | 1.412 | 1.431 | 1.440 | 1.450 | 1.468 | 1.486 | 1.503 | 1.520 | 1.536 | 1.552 | 1.568 | 1.583 | 1.598 | 1.612 | 1.626 | 1.640 | 1.654 | 1.667 | 1.679 | 1.692 | 1.705 |
| 42 | | 1.379 | 1.398 | 1.417 | 1.426 | 1.435 | 1.453 | 1.470 | 1.487 | 1.504 | 1.520 | 1.535 | 1.551 | 1.566 | 1.580 | 1.595 | 1.608 | 1.622 | 1.635 | 1.648 | 1.661 | 1.674 | 1.686 |
| 44 | | 1.366 | 1.385 | 1.403 | 1.412 | 1.421 | 1.439 | 1.456 | 1.472 | 1.488 | 1.504 | 1.520 | 1.535 | 1.549 | 1.564 | 1.578 | 1.592 | 1.605 | 1.618 | 1.631 | 1.644 | 1.656 | 1.668 |
| 46 | | 1.355 | 1.373 | 1.391 | 1.400 | 1.408 | 1.425 | 1.442 | 1.458 | 1.474 | 1.490 | 1.505 | 1.520 | 1.534 | 1.548 | 1.562 | 1.576 | 1.589 | 1.602 | 1.615 | 1.627 | 1.639 | 1.651 |
| 48 | | 1.344 | 1.362 | 1.379 | 1.388 | 1.396 | 1.413 | 1.429 | 1.445 | 1.461 | 1.476 | 1.491 | 1.505 | 1.520 | 1.533 | 1.547 | 1.561 | 1.574 | 1.586 | 1.599 | 1.611 | 1.623 | 1.635 |
| 50 | | 1.333 | 1.351 | 1.368 | 1.377 | 1.385 | 1.401 | 1.417 | 1.433 | 1.448 | 1.463 | 1.478 | 1.492 | 1.506 | 1.520 | 1.533 | 1.546 | 1.559 | 1.572 | 1.584 | 1.596 | 1.608 | 1.620 |
| 52 | | 1.324 | 1.341 | 1.358 | 1.366 | 1.374 | 1.390 | 1.406 | 1.421 | 1.436 | 1.451 | 1.465 | 1.479 | 1.493 | 1.506 | 1.520 | 1.533 | 1.545 | 1.558 | 1.570 | 1.582 | 1.594 | 1.605 |
| 54 | | 1.315 | 1.331 | 1.348 | 1.356 | 1.364 | 1.380 | 1.395 | 1.412 | 1.425 | 1.439 | 1.453 | 1.467 | 1.481 | 1.494 | 1.507 | 1.520 | 1.532 | 1.544 | 1.557 | 1.568 | 1.580 | 1.591 |
| 56 | | 1.306 | 1.322 | 1.339 | 1.346 | 1.354 | 1.370 | 1.385 | 1.399 | 1.414 | 1.428 | 1.442 | 1.455 | 1.469 | 1.482 | 1.495 | 1.507 | 1.520 | 1.532 | 1.544 | 1.555 | 1.567 | 1.578 |
| 58 | | 1.298 | 1.314 | 1.330 | 1.337 | 1.345 | 1.360 | 1.375 | 1.389 | 1.404 | 1.417 | 1.431 | 1.445 | 1.458 | 1.471 | 1.483 | 1.496 | 1.508 | 1.520 | 1.531 | 1.543 | 1.554 | 1.565 |
| 60 | | 1.290 | 1.306 | 1.321 | 1.329 | 1.336 | 1.351 | 1.366 | 1.380 | 1.394 | 1.408 | 1.421 | 1.434 | 1.447 | 1.460 | 1.472 | 1.484 | 1.496 | 1.508 | 1.520 | 1.531 | 1.542 | 1.553 |
| 63 | | 1.279 | 1.295 | 1.310 | 1.317 | 1.324 | 1.339 | 1.353 | 1.366 | 1.380 | 1.393 | 1.406 | 1.419 | 1.432 | 1.444 | 1.457 | 1.468 | 1.480 | 1.492 | 1.503 | 1.514 | 1.525 | 1.536 |
| 66 | | 1.269 | 1.284 | 1.299 | 1.306 | 1.313 | 1.327 | 1.340 | 1.354 | 1.367 | 1.380 | 1.393 | 1.405 | 1.418 | 1.430 | 1.442 | 1.454 | 1.465 | 1.476 | 1.487 | 1.498 | 1.509 | 1.520 |
| 69 | | 1.260 | 1.274 | 1.288 | 1.295 | 1.302 | 1.316 | 1.329 | 1.342 | 1.355 | 1.368 | 1.380 | 1.393 | 1.405 | 1.416 | 1.428 | 1.440 | 1.451 | 1.462 | 1.473 | 1.483 | 1.494 | 1.504 |
| 72 | | 1.251 | 1.265 | 1.279 | 1.286 | 1.292 | 1.306 | 1.319 | 1.331 | 1.344 | 1.356 | 1.368 | 1.380 | 1.392 | 1.404 | 1.415 | 1.426 | 1.437 | 1.448 | 1.459 | 1.469 | 1.480 | 1.490 |
| 75 | | 1.243 | 1.257 | 1.270 | 1.276 | 1.283 | 1.296 | 1.309 | 1.321 | 1.333 | 1.345 | 1.357 | 1.369 | 1.380 | 1.392 | 1.403 | 1.414 | 1.425 | 1.435 | 1.446 | 1.456 | 1.466 | 1.476 |
| 78 | | 1.235 | 1.248 | 1.261 | 1.268 | 1.274 | 1.287 | 1.299 | 1.311 | 1.323 | 1.335 | 1.347 | 1.358 | 1.370 | 1.381 | 1.392 | 1.402 | 1.413 | 1.423 | 1.434 | 1.444 | 1.454 | 1.464 |
| 81 | | 1.228 | 1.241 | 1.254 | 1.260 | 1.266 | 1.278 | 1.290 | 1.302 | 1.313 | 1.326 | 1.337 | 1.348 | 1.359 | 1.370 | 1.381 | 1.391 | 1.402 | 1.412 | 1.422 | 1.432 | 1.442 | 1.451 |
| 84 | | 1.221 | 1.234 | 1.246 | 1.262 | 1.258 | 1.270 | 1.282 | 1.294 | 1.305 | 1.316 | 1.328 | 1.339 | 1.349 | 1.360 | 1.370 | 1.381 | 1.391 | 1.401 | 1.411 | 1.421 | 1.430 | 1.440 |
| 23 | $\frac{h}{t_S}$ | 2.019 | 2.265 | 2.523 | 2.656 | 2.792 | 3.070 | 3.358 | 3.653 | 3.956 | 4.265 | 4.581 | 4.903 | 5.229 | 5.561 | 5.897 | 6.237 | 6.581 | 6.928 | 7.280 | 7.634 | 7.991 | 8.351 |
| 24 | | 1.995 | 2.238 | 2.494 | 2.625 | 2.759 | 3.035 | 3.320 | 3.612 | 3.912 | 4.213 | 4.533 | 4.851 | 5.176 | 5.505 | 5.839 | 6.176 | 6.518 | 6.864 | 7.212 | 7.565 | 7.920 | 8.279 |
| 25 | | 1.972 | 2.212 | 2.465 | 2.595 | 2.728 | 3.000 | 3.282 | 3.572 | 3.870 | 4.163 | 4.485 | 4.801 | 5.123 | 5.450 | 5.782 | 6.117 | 6.457 | 6.800 | 7.146 | 7.498 | 7.851 | 8.207 |
| 26 | | 1.950 | 2.187 | 2.436 | 2.565 | 2.697 | 2.967 | 3.246 | 3.533 | 3.828 | 4.112 | 4.438 | 4.752 | 5.072 | 5.397 | 5.726 | 6.059 | 6.397 | 6.738 | 7.082 | 7.432 | 7.783 | 8.138 |
| 27 | | 1.930 | 2.162 | 2.409 | 2.537 | 2.667 | 2.934 | 3.211 | 3.495 | 3.788 | 4.063 | 4.393 | 4.705 | 5.022 | 5.344 | 5.671 | 6.002 | 6.338 | 6.677 | 7.019 | 7.367 | 7.716 | 8.069 |
| 28 | | 1.907 | 2.139 | 2.383 | 2.509 | 2.637 | 2.902 | 3.176 | 3.458 | 3.748 | 4.016 | 4.349 | 4.658 | 4.973 | 5.293 | 5.618 | 5.947 | 6.281 | 6.618 | 6.958 | 7.304 | 7.651 | 8.002 |
| 29 | | 1.886 | 2.115 | 2.357 | 2.481 | 2.609 | 2.871 | 3.142 | 3.422 | 3.709 | 3.969 | 4.305 | 4.612 | 4.926 | 5.243 | 5.565 | 5.892 | 6.224 | 6.559 | 6.897 | 7.241 | 7.587 | 7.936 |
| 30 | | 1.866 | 2.093 | 2.332 | 2.455 | 2.581 | 2.841 | 3.110 | 3.387 | 3.672 | 3.924 | 4.263 | 4.567 | 4.878 | 5.193 | 5.514 | 5.839 | 6.168 | 6.502 | 6.838 | 7.180 | 7.524 | 7.871 |
| 31 | | 1.847 | 2.071 | 2.307 | 2.429 | 2.554 | 2.811 | 3.078 | 3.352 | 3.635 | 3.880 | 4.221 | 4.524 | 4.832 | 5.145 | 5.464 | 5.787 | 6.114 | 6.445 | 6.780 | 7.120 | 7.462 | 7.807 |
| 32 | | 1.828 | 2.050 | 2.283 | 2.404 | 2.529 | 2.783 | 3.047 | 3.319 | 3.600 | 3.836 | 4.181 | 4.481 | 4.787 | 5.098 | 5.414 | 5.736 | 6.061 | 6.390 | 6.722 | 7.061 | 7.401 | 7.744 |
| 33 | | 1.809 | 2.029 | 2.260 | 2.380 | 2.502 | 2.755 | 3.016 | 3.286 | 3.564 | 3.794 | 4.141 | 4.439 | 4.743 | 5.052 | 5.366 | 5.685 | 6.008 | 6.336 | 6.666 | 7.003 | 7.341 | 7.683 |
| 34 | | 1.792 | 2.009 | 2.237 | 2.356 | 2.477 | 2.727 | 2.986 | 3.254 | 3.530 | 3.752 | 4.102 | 4.398 | 4.700 | 5.007 | 5.319 | 5.636 | 5.957 | 6.282 | 6.611 | 6.945 | 7.282 | 7.622 |
| 35 | | 1.774 | 1.989 | 2.215 | 2.333 | 2.453 | 2.701 | 2.957 | 3.222 | 3.496 | 3.712 | 4.064 | 4.358 | 4.657 | 4.962 | 5.272 | 5.587 | 5.907 | 6.230 | 6.557 | 6.889 | 7.224 | 7.563 |
| 36 | | 1.757 | 1.970 | 2.194 | 2.310 | 2.429 | 2.674 | 2.929 | 3.192 | 3.463 | 3.672 | 4.027 | 4.318 | 4.616 | 4.919 | 5.227 | 5.540 | 5.857 | 6.179 | 6.503 | 6.834 | 7.167 | 7.504 |
| 37 | | 1.741 | 1.951 | 2.173 | 2.288 | 2.406 | 2.649 | 2.901 | 3.162 | 3.431 | 3.633 | 3.990 | 4.280 | 4.576 | 4.876 | 5.182 | 5.493 | 5.809 | 6.128 | 6.451 | 6.780 | 7.111 | 7.446 |
| 38 | | 1.725 | 1.933 | 2.153 | 2.267 | 2.383 | 2.624 | 2.877 | 3.133 | 3.400 | 3.595 | 3.955 | 4.242 | 4.535 | 4.834 | 5.138 | 5.447 | 5.761 | 6.078 | 6.400 | 6.727 | 7.056 | 7.390 |
| 39 | | 1.709 | 1.915 | 2.133 | 2.246 | 2.361 | 2.600 | 2.848 | 3.104 | 3.369 | 3.558 | 3.920 | 4.205 | 4.496 | 4.793 | 5.095 | 5.402 | 3.714 | 6.030 | 6.349 | 6.675 | 7.002 | 7.334 |
| 40 | | 1.694 | 1.898 | 2.113 | 2.225 | 2.340 | 2.576 | 2.822 | 3.076 | 3.338 | 3.521 | 3.885 | 4.168 | 4.458 | 4.753 | 5.053 | 5.358 | 5.668 | 5.982 | 6.299 | 6.623 | 6.949 | 7.279 |

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TABLE 3.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.51;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 19.56;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 19.06;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.14;\ \frac{p}{t_S} = 10.92\right]$ - Concluded

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | $\frac{\bar{h}}{t_S}$ | 1.664 | 1.864 | 2.076 | 2.184 | 2.298 | 2.530 | 2.772 | 3.022 | 3.280 | 3.450 | 3.819 | 4.098 | 4.383 | 4.674 | 4.971 | 5.272 | 5.578 | 5.889 | 6.203 | 6.523 | 6.845 | 7.172 |
| 44 | | 1.637 | 1.832 | 2.040 | 2.147 | 2.258 | 2.486 | 2.724 | 2.970 | 3.224 | 3.382 | 3.755 | 4.028 | 4.311 | 4.598 | 4.891 | 5.189 | 5.491 | 5.798 | 6.109 | 6.426 | 6.745 | 7.068 |
| 46 | | 1.610 | 1.802 | 2.005 | 2.111 | 2.220 | 2.444 | 2.678 | 2.920 | 3.170 | 3.317 | 3.693 | 3.964 | 4.242 | 4.526 | 4.816 | 5.109 | 5.408 | 5.711 | 6.009 | 6.332 | 6.648 | 6.967 |
| 48 | | 1.585 | 1.773 | 1.973 | 2.077 | 2.183 | 2.404 | 2.633 | 2.872 | 3.118 | 3.254 | 3.634 | 3.901 | 4.176 | 4.455 | 4.741 | 5.031 | 5.327 | 5.627 | 5.931 | 6.241 | 6.553 | 6.870 |
| 50 | | 1.560 | 1.745 | 1.941 | 2.043 | 2.148 | 2.365 | 2.591 | 2.826 | 3.069 | 3.193 | 3.577 | 3.841 | 4.111 | 4.387 | 4.669 | 4.956 | 5.249 | 5.545 | 5.846 | 6.152 | 6.462 | 6.775 |
| 52 | | 1.537 | 1.718 | 1.911 | 2.012 | 2.115 | 2.328 | 2.550 | 2.781 | 3.021 | 3.135 | 3.521 | 3.782 | 4.049 | 4.322 | 4.600 | 4.884 | 5.173 | 5.466 | 5.763 | 6.067 | 6.373 | 6.683 |
| 54 | | 1.515 | 1.693 | 1.882 | 1.981 | 2.082 | 2.292 | 2.511 | 2.739 | 2.974 | 3.079 | 3.468 | 3.725 | 3.989 | 4.258 | 4.533 | 4.814 | 5.099 | 5.389 | 5.683 | 5.983 | 6.287 | 6.594 |
| 56 | | 1.494 | 1.668 | 1.855 | 1.952 | 2.051 | 2.258 | 2.473 | 2.698 | 2.930 | 3.024 | 3.417 | 3.671 | 3.931 | 4.197 | 4.469 | 4.746 | 5.028 | 5.315 | 5.606 | 5.903 | 6.203 | 6.507 |
| 58 | | 1.473 | 1.645 | 1.828 | 1.924 | 2.022 | 2.225 | 2.437 | 2.658 | 2.887 | 2.972 | 3.367 | 3.618 | 3.875 | 4.137 | 4.406 | 4.680 | 4.959 | 5.243 | 5.531 | 5.825 | 6.122 | 6.423 |
| 60 | | 1.454 | 1.622 | 1.803 | 1.896 | 1.993 | 2.193 | 2.402 | 2.620 | 2.846 | 2.921 | 3.319 | 3.574 | 3.820 | 4.080 | 4.345 | 4.616 | 4.892 | 5.173 | 5.457 | 5.748 | 6.043 | 6.341 |
| 63 | | 1.426 | 1.590 | 1.766 | 1.858 | 1.952 | 2.147 | 2.352 | 2.565 | 2.786 | 2.849 | 3.251 | 3.493 | 3.742 | 3.997 | 4.258 | 4.524 | 4.795 | 5.071 | 5.352 | 5.638 | 5.928 | 6.222 |
| 66 | | 1.399 | 1.560 | 1.731 | 1.821 | 1.913 | 2.104 | 2.304 | 2.513 | 2.729 | 2.779 | 3.185 | 3.423 | 3.667 | 3.918 | 4.174 | 4.436 | 4.703 | 4.975 | 5.251 | 5.533 | 5.818 | 6.108 |
| 69 | | 1.374 | 1.531 | 1.699 | 1.786 | 1.876 | 2.063 | 2.256 | 2.463 | 2.675 | 2.713 | 3.122 | 3.356 | 3.596 | 3.842 | 4.094 | 4.351 | 4.614 | 4.882 | 5.153 | 5.431 | 5.713 | 5.998 |
| 72 | | 1.351 | 1.504 | 1.668 | 1.753 | 1.841 | 2.024 | 2.216 | 2.416 | 2.624 | 2.643 | 3.063 | 3.292 | 3.528 | 3.770 | 4.017 | 4.271 | 4.529 | 4.792 | 5.060 | 5.334 | 5.611 | 5.893 |
| 75 | | 1.328 | 1.478 | 1.638 | 1.722 | 1.808 | 1.988 | 2.175 | 2.371 | 2.575 | 2.590 | 3.005 | 3.231 | 3.463 | 3.700 | 3.944 | 4.193 | 4.448 | 4.707 | 4.971 | 5.241 | 5.514 | 5.792 |
| 78 | | 1.307 | 1.454 | 1.610 | 1.692 | 1.776 | 1.952 | 2.136 | 2.328 | 2.528 | 2.533 | 2.951 | 3.172 | 3.400 | 3.634 | 3.874 | 4.119 | 4.369 | 4.625 | 4.886 | 5.151 | 5.420 | 5.694 |
| 81 | | 1.287 | 1.430 | 1.583 | 1.664 | 1.746 | 1.918 | 2.099 | 2.287 | 2.484 | 2.478 | 2.899 | 3.116 | 3.340 | 3.570 | 3.806 | 4.047 | 4.294 | 4.546 | 4.802 | 5.064 | 5.330 | 5.600 |
| 84 | | 1.268 | 1.408 | 1.558 | 1.637 | 1.718 | 1.886 | 2.063 | 2.248 | 2.441 | 2.426 | 2.849 | 3.062 | 3.283 | 3.509 | 3.741 | 3.979 | 4.222 | 4.470 | 4.722 | 4.980 | 5.242 | 5.509 |
| 23 | $\frac{\rho}{t_S}$ | 3.066 | 3.468 | 3.876 | 4.081 | 4.287 | 4.701 | 5.118 | 5.538 | 5.959 | 6.381 | 6.805 | 7.229 | 7.654 | 8.080 | 8.506 | 8.933 | 9.360 | 9.787 | 10.21 | 10.64 | 11.07 | 11.50 |
| 24 | | 3.048 | 3.449 | 3.855 | 4.059 | 4.265 | 4.679 | 5.095 | 5.513 | 5.934 | 6.359 | 6.779 | 7.204 | 7.628 | 8.053 | 8.479 | 8.905 | 9.332 | 9.759 | 10.19 | 10.61 | 11.04 | 11.47 |
| 25 | | 3.030 | 3.429 | 3.834 | 4.038 | 4.243 | 4.656 | 5.071 | 5.489 | 5.909 | 6.336 | 6.753 | 7.176 | 7.601 | 8.026 | 8.451 | 8.878 | 9.304 | 9.731 | 10.16 | 10.59 | 11.01 | 11.44 |
| 26 | | 3.013 | 3.411 | 3.814 | 4.018 | 4.222 | 4.634 | 5.048 | 5.465 | 5.884 | 6.314 | 6.728 | 7.150 | 7.574 | 7.999 | 8.424 | 8.850 | 9.276 | 9.703 | 10.13 | 10.56 | 10.98 | 11.41 |
| 27 | | 2.995 | 3.392 | 3.794 | 3.997 | 4.201 | 4.612 | 5.025 | 5.442 | 5.860 | 6.291 | 6.701 | 7.124 | 7.547 | 7.972 | 8.397 | 8.822 | 9.248 | 9.675 | 10.10 | 10.53 | 10.96 | 11.38 |
| 28 | | 2.978 | 3.373 | 3.774 | 3.977 | 4.180 | 4.590 | 5.003 | 5.418 | 5.836 | 6.269 | 6.676 | 7.098 | 7.521 | 7.945 | 8.370 | 8.795 | 9.221 | 9.647 | 10.07 | 10.50 | 10.93 | 11.35 |
| 29 | | 2.961 | 3.355 | 3.755 | 3.957 | 4.159 | 4.568 | 4.980 | 5.395 | 5.812 | 6.247 | 6.650 | 7.072 | 7.495 | 7.918 | 8.343 | 8.768 | 9.193 | 9.619 | 10.05 | 10.47 | 10.90 | 11.33 |
| 30 | | 2.945 | 3.337 | 3.736 | 3.937 | 4.139 | 4.547 | 4.958 | 5.373 | 5.788 | 6.225 | 6.626 | 7.047 | 7.469 | 7.892 | 8.316 | 8.741 | 9.166 | 9.591 | 10.02 | 10.44 | 10.87 | 11.30 |
| 31 | | 2.928 | 3.320 | 3.729 | 3.917 | 4.119 | 4.526 | 4.936 | 5.349 | 5.764 | 6.203 | 6.601 | 7.021 | 7.443 | 7.866 | 8.289 | 8.714 | 9.138 | 9.564 | 9.990 | 10.42 | 10.84 | 11.27 |
| 32 | | 2.912 | 3.302 | 3.698 | 3.898 | 4.099 | 4.505 | 4.914 | 5.326 | 5.740 | 6.181 | 6.576 | 6.996 | 7.417 | 7.846 | 8.266 | 8.687 | 9.111 | 9.537 | 9.963 | 10.39 | 10.81 | 11.24 |
| 33 | | 2.897 | 3.285 | 3.680 | 3.879 | 4.080 | 4.484 | 4.893 | 5.304 | 5.718 | 6.159 | 6.552 | 6.971 | 7.392 | 7.813 | 8.236 | 8.660 | 9.084 | 9.509 | 9.935 | 10.36 | 10.79 | 11.21 |
| 34 | | 2.881 | 3.268 | 3.661 | 3.860 | 4.061 | 4.464 | 4.871 | 5.282 | 5.695 | 6.137 | 6.527 | 6.946 | 7.366 | 7.788 | 8.210 | 8.633 | 9.057 | 9.482 | 9.908 | 10.33 | 10.76 | 11.19 |
| 35 | | 2.866 | 3.251 | 3.644 | 3.842 | 4.041 | 4.444 | 4.850 | 5.259 | 5.672 | 6.116 | 6.503 | 6.921 | 7.341 | 7.762 | 8.184 | 8.607 | 9.031 | 9.455 | 9.803 | 10.31 | 10.73 | 11.16 |
| 36 | | 2.850 | 3.235 | 3.626 | 3.824 | 4.023 | 4.424 | 4.829 | 5.238 | 5.650 | 6.094 | 6.479 | 6.897 | 7.316 | 7.736 | 8.158 | 8.581 | 9.004 | 9.428 | 9.853 | 10.28 | 10.70 | 11.13 |
| 37 | | 2.835 | 3.218 | 3.608 | 3.805 | 4.004 | 4.404 | 4.809 | 5.216 | 5.627 | 6.073 | 6.456 | 6.873 | 7.291 | 7.711 | 8.132 | 8.555 | 8.977 | 9.401 | 9.826 | 10.25 | 10.68 | 11.10 |
| 38 | | 2.821 | 3.202 | 3.591 | 3.788 | 3.986 | 4.385 | 4.787 | 5.195 | 5.605 | 6.052 | 6.432 | 6.849 | 7.267 | 7.686 | 8.107 | 8.528 | 8.951 | 9.374 | 9.799 | 10.22 | 10.65 | 11.07 |
| 39 | | 2.806 | 3.187 | 3.574 | 3.770 | 3.967 | 4.366 | 4.768 | 5.174 | 5.583 | 6.031 | 6.409 | 6.825 | 7.242 | 7.661 | 8.081 | 8.503 | 8.925 | 9.348 | 9.772 | 10.20 | 10.62 | 11.05 |
| 40 | | 2.792 | 3.171 | 3.557 | 3.753 | 3.949 | 4.347 | 4.749 | 5.153 | 5.562 | 6.010 | 6.386 | 6.801 | 7.218 | 7.636 | 8.056 | 8.477 | 8.899 | 9.321 | 9.745 | 10.17 | 10.59 | 11.02 |
| 42 | | 2.764 | 3.140 | 3.524 | 3.719 | 3.914 | 4.309 | 4.709 | 5.113 | 5.519 | 5.968 | 6.340 | 6.754 | 7.169 | 7.587 | 8.006 | 8.426 | 8.847 | 9.269 | 9.692 | 10.12 | 10.54 | 10.96 |
| 44 | | 2.736 | 3.111 | 3.492 | 3.686 | 3.880 | 4.273 | 4.671 | 5.072 | 5.477 | 5.928 | 6.296 | 6.709 | 7.123 | 7.539 | 7.957 | 8.376 | 8.796 | 9.217 | 9.640 | 10.06 | 10.49 | 10.91 |
| 46 | | 2.710 | 3.082 | 3.461 | 3.653 | 3.846 | 4.237 | 4.633 | 5.033 | 5.436 | 5.887 | 6.252 | 6.663 | 7.076 | 7.491 | 7.908 | 8.326 | 8.745 | 9.166 | 9.592 | 10.01 | 10.43 | 10.86 |
| 48 | | 2.685 | 3.053 | 3.430 | 3.621 | 3.814 | 4.202 | 4.596 | 4.994 | 5.396 | 5.848 | 6.208 | 6.618 | 7.031 | 7.445 | 7.860 | 8.277 | 8.695 | 9.115 | 9.536 | 9.957 | 10.38 | 10.80 |
| 50 | | 2.660 | 3.026 | 3.400 | 3.590 | 3.782 | 4.169 | 4.560 | 4.956 | 5.357 | 5.809 | 6.166 | 6.575 | 6.985 | 7.398 | 7.813 | 8.229 | 8.646 | 9.065 | 9.486 | 9.905 | 10.33 | 10.75 |
| 52 | | 2.635 | 2.999 | 3.371 | 3.560 | 3.750 | 4.135 | 4.525 | 4.919 | 5.318 | 5.770 | 6.124 | 6.532 | 6.941 | 7.353 | 7.766 | 8.181 | 8.598 | 9.016 | 9.435 | 9.854 | 10.28 | 10.70 |
| 54 | | 2.611 | 2.973 | 3.343 | 3.530 | 3.720 | 4.102 | 4.491 | 4.873 | 5.280 | 5.732 | 6.083 | 6.489 | 6.897 | 7.308 | 7.720 | 8.134 | 8.550 | 8.967 | 9.385 | 9.804 | 10.22 | 10.64 |
| 56 | | 2.588 | 2.947 | 3.316 | 3.502 | 3.690 | 4.071 | 4.457 | 4.848 | 5.243 | 5.680 | 6.043 | 6.447 | 6.854 | 7.264 | 7.675 | 8.088 | 8.502 | 8.918 | 9.336 | 9.754 | 10.17 | 10.59 |
| 58 | | 2.565 | 2.923 | 3.288 | 3.473 | 3.661 | 4.039 | 4.424 | 4.813 | 5.206 | 5.658 | 6.003 | 6.406 | 6.812 | 7.184 | 7.630 | 8.042 | 8.456 | 8.871 | 9.287 | 9.704 | 10.12 | 10.54 |
| 60 | | 2.544 | 2.898 | 3.261 | 3.446 | 3.632 | 4.009 | 4.391 | 4.779 | 5.170 | 5.622 | 5.964 | 6.363 | 6.770 | 7.177 | 7.586 | 7.997 | 8.410 | 8.824 | 9.239 | 9.656 | 10.07 | 10.49 |
| 63 | | 2.512 | 2.863 | 3.223 | 3.406 | 3.590 | 3.964 | 4.344 | 4.728 | 5.118 | 5.568 | 5.907 | 6.307 | 6.709 | 7.114 | 7.521 | 7.930 | 8.341 | 8.754 | 9.168 | 9.635 | 10.00 | 10.42 |
| 66 | | 2.481 | 2.829 | 3.186 | 3.367 | 3.550 | 3.921 | 4.299 | 4.680 | 5.067 | 5.516 | 5.851 | 6.249 | 6.649 | 7.052 | 7.458 | 7.865 | 8.275 | 8.686 | 9.099 | 9.512 | 9.928 | 10.34 |
| 69 | | 2.452 | 2.796 | 3.150 | 3.329 | 3.511 | 3.879 | 4.255 | 4.633 | 5.017 | 5.465 | 5.797 | 6.193 | 6.591 | 6.992 | 7.396 | 7.802 | 8.209 | 8.619 | 9.031 | 9.443 | 9.857 | 10.27 |
| 72 | | 2.423 | 2.764 | 3.115 | 3.293 | 3.473 | 3.839 | 4.210 | 4.587 | 4.969 | 5.418 | 5.744 | 6.138 | 6.534 | 6.933 | 7.335 | 7.739 | 8.145 | 8.553 | 8.963 | 9.374 | 9.787 | 10.20 |
| 75 | | 2.396 | 2.733 | 3.081 | 3.258 | 3.437 | 3.799 | 4.168 | 4.542 | 4.922 | 5.367 | 5.693 | 6.084 | 6.478 | 6.875 | 7.276 | 7.678 | 8.082 | 8.489 | 8.898 | 9.307 | 9.719 | 10.13 |
| 78 | | 2.368 | 2.704 | 3.048 | 3.224 | 3.401 | 3.761 | 4.127 | 4.499 | 4.876 | 5.320 | 5.642 | 6.031 | 6.424 | 6.819 | 7.217 | 7.618 | 8.021 | 8.426 | 8.833 | 9.241 | 9.651 | 10.06 |
| 81 | | 2.343 | 2.675 | 3.017 | 3.191 | 3.367 | 3.724 | 4.087 | 4.457 | 4.831 | 5.273 | 5.593 | 5.980 | 6.370 | 6.764 | 7.160 | 7.559 | 7.961 | 8.364 | 8.770 | 9.176 | 9.585 | 9.995 |
| 84 | | 2.317 | 2.647 | 2.986 | 3.158 | 3.333 | 3.688 | 4.049 | 4.415 | 4.788 | 5.228 | 5.547 | 5.930 | 6.319 | 6.710 | 7.106 | 7.502 | 7.901 | 8.303 | 8.707 | 9.113 | 9.520 | 9.929 |

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TABLE 4.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.63;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 18.25;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 17.75;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.44;\ \frac{p}{t_S} = 11.72\right]$

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | $\frac{\bar{t}}{t_S}$ | 1.760 | 1.793 | 1.825 | 1.840 | 1.855 | 1.884 | 1.911 | 1.938 | 1.963 | 1.988 | 2.011 | 2.034 | 2.056 | 2.077 | 2.097 | 2.117 | 2.136 | 2.154 | 2.172 | 2.189 | 2.206 | 2.221 |
| 24 | | 1.743 | 1.775 | 1.807 | 1.822 | 1.837 | 1.865 | 1.893 | 1.919 | 1.944 | 1.969 | 1.992 | 2.015 | 2.037 | 2.058 | 2.078 | 2.097 | 2.117 | 2.135 | 2.153 | 2.170 | 2.186 | 2.202 |
| 25 | | 1.727 | 1.759 | 1.790 | 1.805 | 1.820 | 1.848 | 1.878 | 1.901 | 1.926 | 1.951 | 1.974 | 1.997 | 2.018 | 2.039 | 2.060 | 2.079 | 2.098 | 2.116 | 2.134 | 2.151 | 2.168 | 2.184 |
| 26 | | 1.711 | 1.743 | 1.774 | 1.788 | 1.803 | 1.831 | 1.858 | 1.884 | 1.909 | 1.933 | 1.956 | 1.979 | 2.001 | 2.021 | 2.042 | 2.061 | 2.080 | 2.098 | 2.116 | 2.133 | 2.150 | 2.166 |
| 27 | | 1.696 | 1.728 | 1.758 | 1.773 | 1.787 | 1.815 | 1.842 | 1.868 | 1.892 | 1.916 | 1.940 | 1.962 | 1.984 | 2.004 | 2.025 | 2.044 | 2.063 | 2.081 | 2.099 | 2.116 | 2.133 | 2.149 |
| 28 | | 1.682 | 1.713 | 1.743 | 1.758 | 1.772 | 1.799 | 1.826 | 1.852 | 1.876 | 1.902 | 1.923 | 1.946 | 1.967 | 1.988 | 2.008 | 2.027 | 2.046 | 2.064 | 2.082 | 2.099 | 2.116 | 2.132 |
| 29 | | 1.668 | 1.699 | 1.729 | 1.743 | 1.757 | 1.784 | 1.811 | 1.836 | 1.861 | 1.885 | 1.908 | 1.930 | 1.951 | 1.972 | 1.992 | 2.011 | 2.030 | 2.048 | 2.066 | 2.083 | 2.100 | 2.116 |
| 30 | | 1.655 | 1.685 | 1.715 | 1.729 | 1.743 | 1.770 | 1.795 | 1.821 | 1.846 | 1.870 | 1.892 | 1.914 | 1.936 | 1.956 | 1.976 | 1.995 | 2.013 | 2.032 | 2.050 | 2.067 | 2.084 | 2.098 |
| 31 | | 1.642 | 1.672 | 1.701 | 1.715 | 1.729 | 1.756 | 1.782 | 1.807 | 1.831 | 1.855 | 1.878 | 1.899 | 1.921 | 1.941 | 1.961 | 1.980 | 1.999 | 2.017 | 2.035 | 2.052 | 2.068 | 2.085 |
| 32 | | 1.630 | 1.660 | 1.688 | 1.702 | 1.716 | 1.743 | 1.768 | 1.793 | 1.818 | 1.841 | 1.863 | 1.885 | 1.906 | 1.926 | 1.946 | 1.965 | 1.984 | 2.002 | 2.020 | 2.037 | 2.053 | 2.070 |
| 33 | | 1.618 | 1.648 | 1.676 | 1.690 | 1.703 | 1.730 | 1.755 | 1.780 | 1.804 | 1.827 | 1.849 | 1.871 | 1.892 | 1.912 | 1.932 | 1.951 | 1.970 | 1.988 | 2.005 | 2.022 | 2.039 | 2.055 |
| 34 | | 1.607 | 1.636 | 1.664 | 1.678 | 1.691 | 1.717 | 1.743 | 1.767 | 1.791 | 1.815 | 1.836 | 1.857 | 1.878 | 1.899 | 1.918 | 1.937 | 1.956 | 1.974 | 1.991 | 2.008 | 2.025 | 2.041 |
| 35 | | 1.596 | 1.625 | 1.653 | 1.666 | 1.679 | 1.705 | 1.730 | 1.755 | 1.778 | 1.801 | 1.823 | 1.844 | 1.865 | 1.885 | 1.905 | 1.924 | 1.942 | 1.960 | 1.977 | 1.994 | 2.011 | 2.027 |
| 36 | | 1.585 | 1.614 | 1.641 | 1.655 | 1.668 | 1.694 | 1.719 | 1.743 | 1.766 | 1.789 | 1.810 | 1.832 | 1.852 | 1.872 | 1.892 | 1.911 | 1.929 | 1.947 | 1.964 | 1.981 | 1.998 | 2.014 |
| 37 | | 1.575 | 1.603 | 1.631 | 1.644 | 1.657 | 1.682 | 1.707 | 1.731 | 1.754 | 1.776 | 1.798 | 1.819 | 1.840 | 1.860 | 1.879 | 1.898 | 1.916 | 1.934 | 1.951 | 1.968 | 1.984 | 2.001 |
| 38 | | 1.565 | 1.593 | 1.620 | 1.633 | 1.646 | 1.672 | 1.696 | 1.720 | 1.743 | 1.765 | 1.786 | 1.807 | 1.828 | 1.848 | 1.867 | 1.885 | 1.904 | 1.921 | 1.939 | 1.955 | 1.972 | 1.988 |
| 39 | | 1.556 | 1.583 | 1.610 | 1.623 | 1.636 | 1.661 | 1.685 | 1.709 | 1.731 | 1.753 | 1.775 | 1.796 | 1.816 | 1.836 | 1.855 | 1.873 | 1.892 | 1.909 | 1.926 | 1.943 | 1.959 | 1.975 |
| 40 | | 1.547 | 1.574 | 1.600 | 1.613 | 1.626 | 1.651 | 1.675 | 1.698 | 1.721 | 1.742 | 1.764 | 1.784 | 1.805 | 1.824 | 1.843 | 1.862 | 1.880 | 1.897 | 1.914 | 1.931 | 1.947 | 1.963 |
| 42 | | 1.529 | 1.556 | 1.582 | 1.594 | 1.607 | 1.631 | 1.655 | 1.678 | 1.700 | 1.721 | 1.742 | 1.763 | 1.783 | 1.802 | 1.821 | 1.839 | 1.857 | 1.874 | 1.891 | 1.908 | 1.924 | 1.940 |
| 44 | | 1.513 | 1.539 | 1.564 | 1.582 | 1.589 | 1.613 | 1.636 | 1.658 | 1.680 | 1.701 | 1.722 | 1.742 | 1.762 | 1.781 | 1.800 | 1.818 | 1.835 | 1.853 | 1.870 | 1.886 | 1.902 | 1.918 |
| 46 | | 1.497 | 1.523 | 1.548 | 1.560 | 1.572 | 1.595 | 1.618 | 1.640 | 1.662 | 1.683 | 1.703 | 1.723 | 1.742 | 1.761 | 1.780 | 1.797 | 1.815 | 1.832 | 1.858 | 1.865 | 1.881 | 1.896 |
| 48 | | 1.483 | 1.508 | 1.532 | 1.548 | 1.556 | 1.579 | 1.601 | 1.623 | 1.644 | 1.665 | 1.685 | 1.704 | 1.724 | 1.742 | 1.760 | 1.778 | 1.795 | 1.812 | 1.829 | 1.845 | 1.861 | 1.876 |
| 50 | | 1.469 | 1.494 | 1.517 | 1.529 | 1.541 | 1.563 | 1.585 | 1.607 | 1.628 | 1.648 | 1.668 | 1.687 | 1.706 | 1.724 | 1.742 | 1.760 | 1.777 | 1.794 | 1.810 | 1.826 | 1.842 | 1.857 |
| 52 | | 1.456 | 1.480 | 1.504 | 1.515 | 1.526 | 1.549 | 1.570 | 1.591 | 1.612 | 1.632 | 1.651 | 1.670 | 1.689 | 1.707 | 1.725 | 1.742 | 1.759 | 1.776 | 1.792 | 1.808 | 1.823 | 1.838 |
| 54 | | 1.444 | 1.467 | 1.490 | 1.502 | 1.513 | 1.535 | 1.556 | 1.577 | 1.597 | 1.616 | 1.636 | 1.654 | 1.673 | 1.691 | 1.708 | 1.725 | 1.742 | 1.758 | 1.775 | 1.790 | 1.806 | 1.821 |
| 56 | | 1.432 | 1.455 | 1.478 | 1.489 | 1.500 | 1.521 | 1.542 | 1.563 | 1.582 | 1.602 | 1.621 | 1.639 | 1.657 | 1.675 | 1.692 | 1.709 | 1.726 | 1.742 | 1.758 | 1.773 | 1.789 | 1.804 |
| 58 | | 1.421 | 1.444 | 1.466 | 1.477 | 1.488 | 1.509 | 1.530 | 1.549 | 1.569 | 1.588 | 1.607 | 1.625 | 1.643 | 1.660 | 1.677 | 1.694 | 1.710 | 1.726 | 1.742 | 1.757 | 1.772 | 1.787 |
| 60 | | 1.411 | 1.433 | 1.455 | 1.465 | 1.476 | 1.497 | 1.517 | 1.537 | 1.556 | 1.575 | 1.593 | 1.611 | 1.629 | 1.646 | 1.663 | 1.679 | 1.695 | 1.711 | 1.727 | 1.742 | 1.757 | 1.772 |
| 63 | | 1.396 | 1.418 | 1.439 | 1.449 | 1.459 | 1.480 | 1.499 | 1.519 | 1.537 | 1.556 | 1.574 | 1.591 | 1.609 | 1.626 | 1.642 | 1.658 | 1.674 | 1.690 | 1.705 | 1.720 | 1.735 | 1.749 |
| 66 | | 1.382 | 1.403 | 1.424 | 1.434 | 1.444 | 1.464 | 1.483 | 1.502 | 1.520 | 1.538 | 1.556 | 1.573 | 1.590 | 1.607 | 1.623 | 1.639 | 1.654 | 1.670 | 1.685 | 1.699 | 1.714 | 1.728 |
| 69 | | 1.369 | 1.390 | 1.410 | 1.420 | 1.430 | 1.449 | 1.468 | 1.486 | 1.504 | 1.522 | 1.539 | 1.556 | 1.572 | 1.589 | 1.605 | 1.620 | 1.636 | 1.651 | 1.665 | 1.680 | 1.694 | 1.708 |
| 72 | | 1.357 | 1.377 | 1.397 | 1.407 | 1.416 | 1.435 | 1.453 | 1.471 | 1.489 | 1.506 | 1.523 | 1.539 | 1.556 | 1.572 | 1.587 | 1.603 | 1.618 | 1.633 | 1.647 | 1.661 | 1.675 | 1.689 |
| 75 | | 1.346 | 1.366 | 1.385 | 1.394 | 1.403 | 1.422 | 1.440 | 1.457 | 1.474 | 1.491 | 1.508 | 1.524 | 1.540 | 1.556 | 1.571 | 1.586 | 1.610 | 1.616 | 1.630 | 1.644 | 1.658 | 1.671 |
| 78 | | 1.336 | 1.355 | 1.373 | 1.382 | 1.392 | 1.409 | 1.427 | 1.444 | 1.461 | 1.477 | 1.494 | 1.510 | 1.525 | 1.541 | 1.556 | 1.571 | 1.585 | 1.599 | 1.614 | 1.627 | 1.641 | 1.654 |
| 81 | | 1.326 | 1.344 | 1.362 | 1.371 | 1.380 | 1.398 | 1.415 | 1.432 | 1.448 | 1.464 | 1.480 | 1.496 | 1.511 | 1.526 | 1.541 | 1.560 | 1.570 | 1.584 | 1.598 | 1.612 | 1.625 | 1.638 |
| 84 | | 1.316 | 1.335 | 1.352 | 1.361 | 1.370 | 1.387 | 1.404 | 1.420 | 1.436 | 1.452 | 1.468 | 1.483 | 1.498 | 1.513 | 1.527 | 1.542 | 1.556 | 1.570 | 1.583 | 1.597 | 1.610 | 1.623 |
| 23 | $\frac{\bar{h}}{t_S}$ | 2.770 | 3.131 | 3.509 | 3.698 | 3.899 | 4.302 | 4.716 | 5.139 | 5.571 | 6.011 | 6.458 | 6.913 | 7.372 | 7.838 | 8.309 | 8.784 | 9.264 | 9.746 | 10.23 | 10.73 | 11.22 | 11.72 |
| 24 | | 2.740 | 3.098 | 3.473 | 3.660 | 3.861 | 4.260 | 4.670 | 5.091 | 5.520 | 5.958 | 6.402 | 6.854 | 7.311 | 7.775 | 8.243 | 8.716 | 9.194 | 9.675 | 10.16 | 10.65 | 11.14 | 11.64 |
| 25 | | 2.712 | 3.067 | 3.438 | 3.624 | 3.823 | 4.219 | 4.636 | 5.044 | 5.471 | 5.906 | 6.348 | 6.797 | 7.252 | 7.713 | 8.179 | 8.650 | 9.125 | 9.604 | 10.09 | 10.58 | 11.07 | 11.56 |
| 26 | | 2.684 | 3.036 | 3.403 | 3.588 | 3.785 | 4.179 | 4.584 | 4.998 | 5.422 | 5.854 | 6.294 | 6.741 | 7.193 | 7.652 | 8.116 | 8.584 | 9.058 | 9.535 | 10.02 | 10.50 | 10.99 | 11.48 |
| 27 | | 2.657 | 3.006 | 3.370 | 3.553 | 3.749 | 4.139 | 4.541 | 4.953 | 5.374 | 5.804 | 6.241 | 6.685 | 7.135 | 7.592 | 8.053 | 8.520 | 8.991 | 9.466 | 9.946 | 10.43 | 10.92 | 11.41 |
| 28 | | 2.630 | 2.976 | 3.338 | 3.519 | 3.713 | 4.101 | 4.500 | 4.909 | 5.327 | 5.750 | 6.189 | 6.631 | 7.079 | 7.533 | 7.992 | 8.457 | 8.926 | 9.399 | 9.877 | 10.36 | 10.84 | 11.33 |
| 29 | | 2.605 | 2.947 | 3.306 | 3.486 | 3.678 | 4.063 | 4.459 | 4.866 | 5.281 | 5.706 | 6.138 | 6.577 | 7.023 | 7.474 | 7.932 | 8.394 | 8.861 | 9.333 | 9.809 | 10.29 | 10.77 | 11.26 |
| 30 | | 2.576 | 2.919 | 3.275 | 3.453 | 3.644 | 4.026 | 4.415 | 4.824 | 5.236 | 5.658 | 6.088 | 6.525 | 6.968 | 7.418 | 7.873 | 8.333 | 8.791 | 9.267 | 9.741 | 10.22 | 10.70 | 11.18 |
| 31 | | 2.555 | 2.892 | 3.244 | 3.421 | 3.611 | 3.990 | 4.381 | 4.782 | 5.192 | 5.612 | 6.039 | 6.473 | 6.914 | 7.361 | 7.815 | 8.272 | 8.736 | 9.203 | 9.675 | 10.15 | 10.63 | 11.11 |
| 32 | | 2.531 | 2.865 | 3.214 | 3.390 | 3.578 | 3.954 | 4.342 | 4.741 | 5.149 | 5.565 | 5.990 | 6.422 | 6.861 | 7.306 | 7.757 | 8.213 | 8.674 | 9.139 | 9.610 | 10.08 | 10.56 | 11.04 |
| 33 | | 2.507 | 2.838 | 3.185 | 3.359 | 3.546 | 3.920 | 4.305 | 4.701 | 5.106 | 5.521 | 5.943 | 6.373 | 6.809 | 7.252 | 7.701 | 8.154 | 8.614 | 9.077 | 9.546 | 10.02 | 10.49 | 10.97 |
| 34 | | 2.485 | 2.813 | 3.156 | 3.330 | 3.515 | 3.886 | 4.268 | 4.661 | 5.064 | 5.472 | 5.896 | 6.324 | 6.758 | 7.198 | 7.645 | 8.097 | 8.554 | 9.015 | 9.482 | 9.952 | 10.43 | 10.90 |
| 35 | | 2.462 | 2.787 | 3.128 | 3.300 | 3.484 | 3.852 | 4.232 | 4.623 | 5.023 | 5.433 | 5.850 | 6.275 | 6.707 | 7.146 | 7.590 | 8.040 | 8.495 | 8.955 | 9.419 | 9.887 | 10.36 | 10.84 |
| 36 | | 2.440 | 2.763 | 3.101 | 3.272 | 3.454 | 3.819 | 4.197 | 4.585 | 4.983 | 5.390 | 5.805 | 6.228 | 6.658 | 7.094 | 7.536 | 7.984 | 8.437 | 8.895 | 9.358 | 9.824 | 10.29 | 10.77 |
| 37 | | 2.419 | 2.739 | 3.074 | 3.243 | 3.425 | 3.787 | 4.162 | 4.548 | 4.943 | 5.348 | 5.760 | 6.181 | 6.609 | 7.043 | 7.483 | 7.929 | 8.380 | 8.835 | 9.296 | 9.761 | 10.23 | 10.70 |
| 38 | | 2.398 | 2.715 | 3.048 | 3.216 | 3.396 | 3.756 | 4.128 | 4.511 | 4.904 | 5.307 | 5.717 | 6.135 | 6.561 | 6.993 | 7.431 | 7.874 | 8.323 | 8.777 | 9.236 | 9.699 | 10.17 | 10.64 |
| 39 | | 2.377 | 2.692 | 3.022 | 3.189 | 3.367 | 3.725 | 4.092 | 4.475 | 4.866 | 5.266 | 5.674 | 6.090 | 6.513 | 6.943 | 7.379 | 7.821 | 8.266 | 8.720 | 9.177 | 9.638 | 10.10 | 10.57 |
| 40 | | 2.357 | 2.669 | 2.997 | 3.162 | 3.340 | 3.695 | 4.062 | 4.440 | 4.828 | 5.226 | 5.635 | 6.046 | 6.466 | 6.894 | 7.328 | 7.768 | 8.213 | 8.663 | 9.118 | 9.578 | 10.04 | 10.51 |

TABLE 4.- HAT PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.63;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 18.25;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 17.75;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.44;\ \frac{p}{t_S} = 11.72\right]$ - Concluded

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | $\frac{\bar{h}}{t_S}$ | 2.318 | 2.625 | 2.948 | 3.111 | 3.286 | 3.636 | 3.998 | 4.372 | 4.755 | 5.148 | 5.549 | 5.959 | 6.375 | 6.799 | 7.229 | 7.664 | 8.106 | 8.552 | 9.004 | 9.459 | 9.919 | 10.38 |
| 44 | | 2.281 | 2.583 | 2.901 | 3.050 | 3.234 | 3.579 | 3.936 | 4.305 | 4.684 | 5.072 | 5.469 | 5.875 | 6.287 | 6.706 | 7.132 | 7.564 | 8.001 | 8.444 | 8.892 | 9.344 | 9.801 | 10.26 |
| 46 | | 2.245 | 2.542 | 2.856 | 3.014 | 3.184 | 3.524 | 3.877 | 4.241 | 4.616 | 5.000 | 5.392 | 5.793 | 6.201 | 6.617 | 7.039 | 7.466 | 7.900 | 8.339 | 8.783 | 9.232 | 9.685 | 10.14 |
| 48 | | 2.211 | 2.503 | 2.812 | 2.968 | 3.136 | 3.471 | 3.820 | 4.179 | 4.549 | 4.929 | 5.317 | 5.714 | 6.118 | 6.529 | 6.948 | 7.371 | 7.801 | 8.237 | 8.677 | 9.122 | 9.572 | 10.03 |
| 50 | | 2.178 | 2.466 | 2.770 | 2.924 | 3.089 | 3.420 | 3.764 | 4.119 | 4.485 | 4.860 | 5.244 | 5.637 | 6.037 | 6.445 | 6.859 | 7.279 | 7.705 | 8.137 | 8.574 | 9.015 | 9.462 | 9.912 |
| 52 | | 2.146 | 2.430 | 2.729 | 2.881 | 3.044 | 3.371 | 3.710 | 4.062 | 4.423 | 4.794 | 5.174 | 5.562 | 5.958 | 6.362 | 6.772 | 7.189 | 7.611 | 8.039 | 8.473 | 8.911 | 9.354 | 9.802 |
| 54 | | 2.115 | 2.395 | 2.690 | 2.840 | 3.000 | 3.323 | 3.658 | 4.005 | 4.362 | 4.730 | 5.105 | 5.490 | 5.882 | 6.282 | 6.689 | 7.101 | 7.520 | 7.945 | 8.400 | 8.810 | 9.250 | 9.694 |
| 56 | | 2.086 | 2.361 | 2.652 | 2.800 | 2.948 | 3.277 | 3.608 | 3.951 | 4.304 | 4.667 | 5.039 | 5.420 | 5.808 | 6.204 | 6.607 | 7.016 | 7.431 | 7.852 | 8.279 | 8.711 | 9.147 | 9.588 |
| 58 | | 2.057 | 2.329 | 2.616 | 2.762 | 2.918 | 3.232 | 3.558 | 3.898 | 4.247 | 4.606 | 4.974 | 5.351 | 5.736 | 6.128 | 6.527 | 6.933 | 7.345 | 7.762 | 8.186 | 8.614 | 9.048 | 9.485 |
| 60 | | 2.030 | 2.298 | 2.581 | 2.724 | 2.879 | 3.189 | 3.512 | 3.847 | 4.192 | 4.547 | 4.912 | 5.285 | 5.665 | 6.054 | 6.450 | 6.852 | 7.260 | 7.674 | 8.094 | 8.519 | 8.949 | 9.384 |
| 63 | | 1.991 | 2.252 | 2.530 | 2.671 | 2.822 | 3.127 | 3.444 | 3.773 | 4.113 | 4.462 | 4.821 | 5.188 | 5.564 | 5.947 | 6.337 | 6.734 | 7.137 | 7.546 | 7.961 | 8.381 | 8.807 | 9.236 |
| 66 | | 1.953 | 2.210 | 2.482 | 2.620 | 2.768 | 3.067 | 3.379 | 3.702 | 4.036 | 4.380 | 4.733 | 5.095 | 5.465 | 5.843 | 6.228 | 6.621 | 7.018 | 7.422 | 7.833 | 8.248 | 8.669 | 9.094 |
| 69 | | 1.918 | 2.169 | 2.435 | 2.571 | 2.717 | 3.010 | 3.317 | 3.635 | 3.963 | 4.302 | 4.642 | 5.006 | 5.371 | 5.744 | 6.124 | 6.510 | 6.904 | 7.303 | 7.709 | 8.119 | 8.535 | 8.956 |
| 72 | | 1.884 | 2.130 | 2.391 | 2.525 | 2.667 | 2.956 | 3.257 | 3.570 | 3.893 | 4.226 | 4.569 | 4.921 | 5.280 | 5.648 | 6.023 | 6.405 | 6.793 | 7.188 | 7.588 | 7.995 | 8.406 | 8.822 |
| 75 | | 1.851 | 2.093 | 2.349 | 2.480 | 2.620 | 2.904 | 3.200 | 3.507 | 3.826 | 4.154 | 4.492 | 4.838 | 5.193 | 5.556 | 5.926 | 6.303 | 6.687 | 7.077 | 7.473 | 7.874 | 8.281 | 8.693 |
| 78 | | 1.821 | 2.057 | 2.309 | 2.438 | 2.575 | 2.854 | 3.119 | 3.448 | 3.761 | 4.084 | 4.417 | 4.759 | 5.109 | 5.467 | 5.832 | 6.204 | 6.584 | 6.969 | 7.361 | 7.758 | 8.160 | 8.568 |
| 81 | | 1.791 | 2.024 | 2.271 | 2.397 | 2.532 | 2.806 | 3.092 | 3.390 | 3.698 | 4.017 | 4.345 | 4.683 | 5.027 | 5.380 | 5.741 | 6.109 | 6.484 | 6.864 | 7.252 | 7.644 | 8.043 | 8.446 |
| 84 | | 1.763 | 1.991 | 2.234 | 2.358 | 2.491 | 2.760 | 3.042 | 3.335 | 3.639 | 3.953 | 4.276 | 4.608 | 4.949 | 5.297 | 5.654 | 6.017 | 6.387 | 6.763 | 7.147 | 7.535 | 7.929 | 8.328 |
| 23 | $\frac{\rho}{t_S}$ | 4.067 | 4.578 | 5.102 | 5.368 | 5.630 | 6.160 | 6.701 | 7.225 | 7.766 | 8.291 | 8.826 | 9.360 | 9.894 | 10.43 | 10.96 | 11.49 | 12.03 | 12.56 | 13.09 | 13.62 | 14.16 | 14.69 |
| 24 | | 4.039 | 4.577 | 5.082 | 5.348 | 5.609 | 6.139 | 6.679 | 7.202 | 7.744 | 8.269 | 8.803 | 9.337 | 9.872 | 10.41 | 10.94 | 11.47 | 12.01 | 12.54 | 13.11 | 13.60 | 14.13 | 14.67 |
| 25 | | 4.021 | 4.540 | 5.063 | 5.328 | 5.589 | 6.118 | 6.661 | 7.180 | 7.721 | 8.246 | 8.780 | 9.314 | 9.848 | 10.39 | 10.92 | 11.45 | 11.98 | 12.52 | 13.08 | 13.58 | 14.11 | 14.64 |
| 26 | | 4.003 | 4.521 | 5.043 | 5.308 | 5.568 | 6.097 | 6.636 | 7.159 | 7.698 | 8.224 | 8.758 | 9.291 | 9.825 | 10.36 | 10.89 | 11.43 | 11.96 | 12.49 | 13.06 | 13.56 | 14.09 | 14.62 |
| 27 | | 3.986 | 4.502 | 5.024 | 5.288 | 5.548 | 6.076 | 6.615 | 7.137 | 7.677 | 8.201 | 8.735 | 9.268 | 9.802 | 10.34 | 10.87 | 11.40 | 11.94 | 12.47 | 13.04 | 13.54 | 14.07 | 14.60 |
| 28 | | 3.968 | 4.484 | 5.006 | 5.268 | 5.528 | 6.056 | 6.593 | 7.115 | 7.655 | 8.177 | 8.713 | 9.245 | 9.779 | 10.31 | 10.85 | 11.38 | 11.91 | 12.45 | 13.02 | 13.51 | 14.04 | 14.58 |
| 29 | | 3.951 | 4.465 | 4.985 | 5.249 | 5.508 | 6.035 | 6.572 | 7.093 | 7.633 | 8.157 | 8.689 | 9.223 | 9.757 | 10.29 | 10.82 | 11.36 | 11.89 | 12.42 | 12.99 | 13.49 | 14.02 | 14.56 |
| 30 | | 3.936 | 4.448 | 4.967 | 5.229 | 5.488 | 6.015 | 6.549 | 7.072 | 7.611 | 8.135 | 8.667 | 9.194 | 9.734 | 10.27 | 10.80 | 11.33 | 11.87 | 12.40 | 12.97 | 13.47 | 14.00 | 14.53 |
| 31 | | 3.918 | 4.430 | 4.948 | 5.210 | 5.469 | 5.994 | 6.530 | 7.060 | 7.609 | 8.112 | 8.645 | 9.177 | 9.711 | 10.24 | 10.78 | 11.31 | 11.84 | 12.38 | 12.95 | 13.44 | 13.98 | 14.51 |
| 32 | | 3.900 | 4.412 | 4.929 | 5.191 | 5.449 | 5.974 | 6.509 | 7.029 | 7.567 | 8.090 | 8.623 | 9.155 | 9.688 | 10.22 | 10.76 | 11.29 | 11.82 | 12.36 | 12.92 | 13.42 | 13.95 | 14.49 |
| 33 | | 3.885 | 4.395 | 4.910 | 5.172 | 5.430 | 5.954 | 6.489 | 7.008 | 7.545 | 8.069 | 8.600 | 9.133 | 9.665 | 10.20 | 10.73 | 11.27 | 11.80 | 12.33 | 12.90 | 13.40 | 13.93 | 14.46 |
| 34 | | 3.868 | 4.377 | 4.892 | 5.153 | 5.411 | 5.934 | 6.468 | 6.987 | 7.524 | 8.045 | 8.578 | 9.110 | 9.643 | 10.17 | 10.71 | 11.24 | 11.78 | 12.31 | 12.88 | 13.38 | 13.91 | 14.44 |
| 35 | | 3.852 | 4.360 | 4.874 | 5.134 | 5.392 | 5.914 | 6.447 | 6.966 | 7.502 | 8.025 | 8.556 | 9.088 | 9.620 | 10.15 | 10.69 | 11.22 | 11.75 | 12.29 | 12.85 | 13.35 | 13.89 | 14.42 |
| 36 | | 3.836 | 4.357 | 4.856 | 5.116 | 5.373 | 5.895 | 6.427 | 6.945 | 7.481 | 8.003 | 8.534 | 9.065 | 9.597 | 10.13 | 10.67 | 11.20 | 11.73 | 12.26 | 12.83 | 13.33 | 13.86 | 14.40 |
| 37 | | 3.821 | 4.326 | 4.838 | 5.098 | 5.354 | 5.876 | 6.407 | 6.924 | 7.460 | 7.981 | 8.512 | 9.043 | 9.575 | 10.11 | 10.64 | 11.17 | 11.71 | 12.24 | 12.81 | 13.31 | 13.84 | 14.37 |
| 38 | | 3.805 | 4.310 | 4.820 | 5.079 | 5.335 | 5.856 | 6.386 | 6.904 | 7.438 | 7.960 | 8.490 | 9.020 | 9.553 | 10.09 | 10.62 | 11.15 | 11.68 | 12.22 | 12.78 | 13.28 | 13.82 | 14.35 |
| 39 | | 3.791 | 4.293 | 4.803 | 5.061 | 5.317 | 5.836 | 6.368 | 6.883 | 7.417 | 7.938 | 8.468 | 8.998 | 9.530 | 10.06 | 10.60 | 11.13 | 11.66 | 12.19 | 12.76 | 13.26 | 13.79 | 14.33 |
| 40 | | 3.774 | 4.277 | 4.785 | 5.043 | 5.299 | 5.817 | 6.347 | 6.863 | 7.396 | 7.917 | 8.445 | 8.977 | 9.508 | 10.04 | 10.57 | 11.11 | 11.64 | 12.17 | 12.74 | 13.24 | 13.77 | 14.30 |
| 42 | | 3.744 | 4.244 | 4.751 | 5.008 | 5.263 | 5.779 | 6.308 | 6.822 | 7.355 | 7.874 | 8.403 | 8.933 | 9.464 | 9.995 | 10.53 | 11.06 | 11.59 | 12.13 | 12.69 | 13.19 | 13.72 | 14.26 |
| 44 | | 3.715 | 4.213 | 4.717 | 4.987 | 5.227 | 5.742 | 6.269 | 6.782 | 7.314 | 7.832 | 8.360 | 8.889 | 9.419 | 9.950 | 10.48 | 11.01 | 11.55 | 12.08 | 12.64 | 13.14 | 13.68 | 14.21 |
| 46 | | 3.686 | 4.182 | 4.684 | 4.939 | 5.192 | 5.704 | 6.230 | 6.743 | 7.273 | 7.791 | 8.318 | 8.846 | 9.375 | 9.906 | 10.44 | 10.97 | 11.50 | 12.03 | 12.60 | 13.10 | 13.67 | 14.16 |
| 48 | | 3.658 | 4.151 | 4.652 | 4.906 | 5.158 | 5.670 | 6.193 | 6.704 | 7.233 | 7.750 | 8.276 | 8.703 | 9.332 | 9.861 | 10.39 | 10.92 | 11.46 | 11.99 | 12.55 | 13.06 | 13.59 | 14.08 |
| 50 | | 3.630 | 4.121 | 4.619 | 4.873 | 5.124 | 5.634 | 6.156 | 6.666 | 7.193 | 7.709 | 8.234 | 8.761 | 9.289 | 9.817 | 10.35 | 10.88 | 11.41 | 11.94 | 12.51 | 13.01 | 13.54 | 14.07 |
| 52 | | 3.603 | 4.092 | 4.588 | 4.840 | 5.090 | 5.599 | 6.119 | 6.627 | 7.154 | 7.669 | 8.193 | 8.718 | 9.246 | 9.774 | 10.30 | 10.83 | 11.36 | 11.90 | 12.46 | 12.96 | 13.49 | 14.03 |
| 54 | | 3.577 | 4.063 | 4.557 | 4.808 | 5.058 | 5.564 | 6.083 | 6.590 | 7.115 | 7.629 | 8.152 | 8.677 | 9.203 | 9.731 | 10.26 | 10.79 | 11.32 | 11.85 | 12.40 | 12.91 | 13.45 | 13.98 |
| 56 | | 3.551 | 4.035 | 4.527 | 4.777 | 5.030 | 5.531 | 6.047 | 6.554 | 7.077 | 7.590 | 8.112 | 8.636 | 9.161 | 9.688 | 10.22 | 10.75 | 11.28 | 11.81 | 12.37 | 12.87 | 13.40 | 13.93 |
| 58 | | 3.525 | 4.007 | 4.497 | 4.746 | 4.994 | 5.497 | 6.011 | 6.517 | 7.039 | 7.551 | 8.072 | 8.595 | 9.119 | 9.645 | 10.17 | 10.70 | 11.23 | 11.76 | 12.32 | 12.83 | 13.35 | 13.89 |
| 60 | | 3.500 | 3.980 | 4.468 | 4.716 | 4.963 | 5.464 | 5.978 | 6.481 | 7.002 | 7.513 | 8.032 | 8.554 | 9.078 | 9.603 | 10.13 | 10.66 | 11.19 | 11.72 | 12.28 | 12.78 | 13.31 | 13.84 |
| 63 | | 3.464 | 3.940 | 4.425 | 4.671 | 4.917 | 5.416 | 5.927 | 6.428 | 6.947 | 7.456 | 7.974 | 8.494 | 9.017 | 9.540 | 10.07 | 10.59 | 11.12 | 11.65 | 12.21 | 12.71 | 13.24 | 13.77 |
| 66 | | 3.428 | 3.901 | 4.383 | 4.628 | 4.872 | 5.369 | 5.877 | 6.376 | 6.893 | 7.400 | 7.916 | 8.435 | 8.956 | 9.479 | 10.00 | 10.53 | 11.06 | 11.59 | 12.14 | 12.64 | 13.17 | 13.71 |
| 69 | | 3.394 | 3.863 | 4.342 | 4.586 | 4.829 | 5.322 | 5.829 | 6.325 | 6.840 | 7.345 | 7.863 | 8.377 | 8.897 | 9.418 | 9.942 | 10.47 | 10.99 | 11.52 | 12.08 | 12.58 | 13.11 | 13.64 |
| 72 | | 3.360 | 3.827 | 4.302 | 4.545 | 4.786 | 5.277 | 5.781 | 6.276 | 6.788 | 7.291 | 7.804 | 8.320 | 8.838 | 9.358 | 9.880 | 10.40 | 10.93 | 11.46 | 12.01 | 12.51 | 13.04 | 13.57 |
| 75 | | 3.328 | 3.791 | 4.264 | 4.504 | 4.745 | 5.233 | 5.734 | 6.227 | 6.737 | 7.238 | 7.750 | 8.264 | 8.781 | 9.299 | 9.820 | 10.34 | 10.87 | 11.39 | 11.95 | 12.45 | 12.98 | 13.50 |
| 78 | | 3.296 | 3.756 | 4.226 | 4.465 | 4.704 | 5.190 | 5.698 | 6.179 | 6.664 | 7.186 | 7.696 | 8.208 | 8.718 | 9.241 | 9.761 | 10.28 | 10.81 | 11.33 | 11.88 | 12.38 | 12.91 | 13.44 |
| 81 | | 3.265 | 3.722 | 4.189 | 4.427 | 4.665 | 5.148 | 5.644 | 6.132 | 6.638 | 7.136 | 7.643 | 8.154 | 8.668 | 9.238 | 9.702 | 10.22 | 10.74 | 11.27 | 11.82 | 12.32 | 12.84 | 13.37 |
| 84 | | 3.235 | 3.689 | 4.153 | 4.390 | 4.626 | 5.107 | 5.600 | 6.083 | 6.590 | 7.086 | 7.592 | 8.100 | 8.613 | 9.127 | 9.644 | 10.16 | 10.68 | 11.21 | 11.76 | 12.25 | 12.78 | 13.31 |

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TABLE 5.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.79;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 17.17;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 16.67;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.82;\ \frac{p}{t_S} = 12.30\right]$

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | $\frac{\bar{t}}{t_S}$ | 2.061 | 2.105 | 2.147 | 2.168 | 2.187 | 2.225 | 2.262 | 2.296 | 2.329 | 2.361 | 2.391 | 2.420 | 2.448 | 2.475 | 2.501 | 2.525 | 2.549 | 2.572 | 2.594 | 2.615 | 2.636 | 2.656 |
| 24 | | 2.039 | 2.083 | 2.125 | 2.145 | 2.165 | 2.203 | 2.239 | 2.273 | 2.306 | 2.338 | 2.368 | 2.397 | 2.425 | 2.452 | 2.477 | 2.502 | 2.526 | 2.549 | 2.571 | 2.592 | 2.613 | 2.633 |
| 25 | | 2.019 | 2.062 | 2.103 | 2.123 | 2.143 | 2.181 | 2.217 | 2.251 | 2.284 | 2.315 | 2.346 | 2.375 | 2.403 | 2.429 | 2.455 | 2.480 | 2.504 | 2.527 | 2.549 | 2.570 | 2.591 | 2.611 |
| 26 | | 1.998 | 2.042 | 2.083 | 2.102 | 2.122 | 2.159 | 2.195 | 2.230 | 2.262 | 2.294 | 2.324 | 2.353 | 2.381 | 2.407 | 2.433 | 2.458 | 2.482 | 2.505 | 2.528 | 2.549 | 2.570 | 2.590 |
| 27 | | 1.979 | 2.022 | 2.063 | 2.082 | 2.102 | 2.139 | 2.175 | 2.209 | 2.241 | 2.273 | 2.303 | 2.332 | 2.360 | 2.386 | 2.412 | 2.437 | 2.461 | 2.484 | 2.507 | 2.528 | 2.549 | 2.569 |
| 28 | | 1.961 | 2.003 | 2.043 | 2.063 | 2.082 | 2.119 | 2.155 | 2.189 | 2.221 | 2.252 | 2.283 | 2.311 | 2.339 | 2.366 | 2.392 | 2.417 | 2.441 | 2.464 | 2.486 | 2.508 | 2.529 | 2.549 |
| 29 | | 1.943 | 1.985 | 2.025 | 2.044 | 2.063 | 2.100 | 2.136 | 2.169 | 2.193 | 2.233 | 2.263 | 2.292 | 2.319 | 2.346 | 2.372 | 2.397 | 2.421 | 2.444 | 2.466 | 2.488 | 2.509 | 2.529 |
| 30 | | 1.925 | 1.967 | 2.007 | 2.026 | 2.045 | 2.082 | 2.117 | 2.150 | 2.183 | 2.214 | 2.244 | 2.273 | 2.300 | 2.327 | 2.353 | 2.377 | 2.401 | 2.425 | 2.447 | 2.469 | 2.488 | 2.510 |
| 31 | | 1.909 | 1.950 | 1.990 | 2.009 | 2.028 | 2.064 | 2.099 | 2.132 | 2.164 | 2.195 | 2.225 | 2.254 | 2.281 | 2.308 | 2.334 | 2.359 | 2.383 | 2.406 | 2.428 | 2.450 | 2.470 | 2.492 |
| 32 | | 1.893 | 1.934 | 1.973 | 1.992 | 2.011 | 2.046 | 2.081 | 2.115 | 2.147 | 2.177 | 2.207 | 2.236 | 2.263 | 2.290 | 2.316 | 2.340 | 2.364 | 2.388 | 2.410 | 2.432 | 2.453 | 2.473 |
| 33 | | 1.877 | 1.918 | 1.957 | 1.976 | 1.994 | 2.030 | 2.064 | 2.097 | 2.129 | 2.160 | 2.190 | 2.218 | 2.246 | 2.272 | 2.298 | 2.323 | 2.336 | 2.370 | 2.392 | 2.414 | 2.435 | 2.456 |
| 34 | | 1.862 | 1.903 | 1.941 | 1.960 | 1.978 | 2.014 | 2.048 | 2.081 | 2.113 | 2.134 | 2.173 | 2.201 | 2.228 | 2.255 | 2.280 | 2.305 | 2.329 | 2.343 | 2.375 | 2.397 | 2.418 | 2.438 |
| 35 | | 1.848 | 1.888 | 1.933 | 1.945 | 1.963 | 1.998 | 2.032 | 2.065 | 2.096 | 2.127 | 2.156 | 2.184 | 2.212 | 2.238 | 2.264 | 2.288 | 2.312 | 2.335 | 2.358 | 2.380 | 2.401 | 2.421 |
| 36 | | 1.834 | 1.873 | 1.911 | 1.930 | 1.948 | 1.983 | 2.017 | 2.049 | 2.081 | 2.111 | 2.140 | 2.168 | 2.195 | 2.222 | 2.247 | 2.272 | 2.296 | 2.319 | 2.341 | 2.363 | 2.384 | 2.405 |
| 37 | | 1.820 | 1.860 | 1.897 | 1.915 | 1.933 | 1.968 | 2.002 | 2.034 | 2.065 | 2.095 | 2.124 | 2.153 | 2.180 | 2.206 | 2.231 | 2.256 | 2.280 | 2.303 | 2.325 | 2.347 | 2.368 | 2.388 |
| 38 | | 1.807 | 1.846 | 1.883 | 1.902 | 1.919 | 1.954 | 1.987 | 2.019 | 2.050 | 2.080 | 2.109 | 2.137 | 2.164 | 2.190 | 2.216 | 2.240 | 2.264 | 2.287 | 2.309 | 2.331 | 2.352 | 2.373 |
| 39 | | 1.795 | 1.833 | 1.870 | 1.888 | 1.906 | 1.940 | 1.973 | 2.005 | 2.036 | 2.066 | 2.094 | 2.122 | 2.149 | 2.175 | 2.200 | 2.225 | 2.249 | 2.272 | 2.294 | 2.316 | 2.337 | 2.357 |
| 40 | | 1.782 | 1.821 | 1.857 | 1.875 | 1.893 | 1.927 | 1.960 | 1.991 | 2.022 | 2.051 | 2.080 | 2.108 | 2.134 | 2.160 | 2.186 | 2.210 | 2.234 | 2.257 | 2.279 | 2.301 | 2.322 | 2.342 |
| 42 | | 1.759 | 1.796 | 1.832 | 1.850 | 1.867 | 1.901 | 1.933 | 1.964 | 1.995 | 2.024 | 2.052 | 2.080 | 2.106 | 2.132 | 2.157 | 2.181 | 2.205 | 2.228 | 2.250 | 2.271 | 2.292 | 2.313 |
| 44 | | 1.737 | 1.774 | 1.809 | 1.826 | 1.843 | 1.876 | 1.908 | 1.939 | 1.969 | 1.998 | 2.026 | 2.053 | 2.079 | 2.105 | 2.130 | 2.154 | 2.177 | 2.200 | 2.222 | 2.244 | 2.265 | 2.285 |
| 46 | | 1.716 | 1.752 | 1.787 | 1.804 | 1.821 | 1.853 | 1.885 | 1.915 | 1.945 | 1.973 | 2.001 | 2.028 | 2.054 | 2.079 | 2.104 | 2.128 | 2.151 | 2.174 | 2.196 | 2.217 | 2.238 | 2.258 |
| 48 | | 1.682 | 1.732 | 1.766 | 1.783 | 1.799 | 1.831 | 1.862 | 1.892 | 1.922 | 1.950 | 1.977 | 2.004 | 2.030 | 2.055 | 2.079 | 2.103 | 2.126 | 2.148 | 2.170 | 2.191 | 2.212 | 2.232 |
| 50 | | 1.678 | 1.713 | 1.746 | 1.763 | 1.779 | 1.810 | 1.841 | 1.871 | 1.899 | 1.927 | 1.954 | 1.981 | 2.006 | 2.031 | 2.055 | 2.079 | 2.102 | 2.124 | 2.146 | 2.167 | 2.188 | 2.208 |
| 52 | | 1.660 | 1.694 | 1.727 | 1.743 | 1.759 | 1.791 | 1.821 | 1.850 | 1.878 | 1.906 | 1.933 | 1.959 | 1.984 | 2.009 | 2.033 | 2.056 | 2.079 | 2.101 | 2.122 | 2.143 | 2.164 | 2.184 |
| 54 | | 1.643 | 1.677 | 1.709 | 1.725 | 1.741 | 1.772 | 1.802 | 1.830 | 1.858 | 1.886 | 1.912 | 1.938 | 1.963 | 1.987 | 2.011 | 2.034 | 2.056 | 2.079 | 2.100 | 2.121 | 2.141 | 2.161 |
| 56 | | 1.627 | 1.660 | 1.692 | 1.708 | 1.723 | 1.754 | 1.783 | 1.811 | 1.839 | 1.866 | 1.892 | 1.918 | 1.943 | 1.967 | 1.990 | 2.013 | 2.035 | 2.057 | 2.078 | 2.099 | 2.119 | 2.139 |
| 58 | | 1.620 | 1.645 | 1.676 | 1.692 | 1.707 | 1.737 | 1.765 | 1.794 | 1.821 | 1.847 | 1.873 | 1.898 | 1.923 | 1.947 | 1.970 | 1.993 | 2.015 | 2.037 | 2.058 | 2.078 | 2.098 | 2.118 |
| 60 | | 1.598 | 1.630 | 1.661 | 1.676 | 1.691 | 1.720 | 1.749 | 1.776 | 1.803 | 1.830 | 1.855 | 1.880 | 1.904 | 1.922 | 1.951 | 1.973 | 1.995 | 2.017 | 2.038 | 2.058 | 2.078 | 2.198 |
| 63 | | 1.577 | 1.608 | 1.639 | 1.653 | 1.668 | 1.697 | 1.725 | 1.752 | 1.778 | 1.804 | 1.829 | 1.854 | 1.878 | 1.901 | 1.924 | 1.946 | 1.967 | 1.989 | 2.009 | 2.030 | 2.049 | 2.068 |
| 66 | | 1.558 | 1.589 | 1.618 | 1.633 | 1.647 | 1.675 | 1.702 | 1.729 | 1.755 | 1.780 | 1.805 | 1.829 | 1.852 | 1.875 | 1.898 | 1.919 | 1.941 | 1.962 | 1.982 | 2.002 | 2.022 | 2.041 |
| 69 | | 1.540 | 1.570 | 1.599 | 1.613 | 1.627 | 1.654 | 1.681 | 1.707 | 1.733 | 1.758 | 1.782 | 1.805 | 1.829 | 1.851 | 1.873 | 1.895 | 1.916 | 1.936 | 1.954 | 1.976 | 1.996 | 2.015 |
| 72 | | 1.524 | 1.553 | 1.581 | 1.595 | 1.608 | 1.635 | 1.661 | 1.687 | 1.711 | 1.736 | 1.760 | 1.783 | 1.806 | 1.828 | 1.850 | 1.871 | 1.892 | 1.912 | 1.932 | 1.952 | 1.971 | 1.990 |
| 75 | | 1.508 | 1.536 | 1.564 | 1.577 | 1.591 | 1.617 | 1.643 | 1.668 | 1.692 | 1.716 | 1.739 | 1.762 | 1.785 | 1.807 | 1.828 | 1.849 | 1.869 | 1.889 | 1.909 | 1.928 | 1.947 | 1.966 |
| 78 | | 1.493 | 1.521 | 1.548 | 1.561 | 1.574 | 1.600 | 1.625 | 1.650 | 1.674 | 1.697 | 1.720 | 1.743 | 1.764 | 1.786 | 1.807 | 1.828 | 1.848 | 1.868 | 1.887 | 1.906 | 1.925 | 1.943 |
| 81 | | 1.479 | 1.506 | 1.532 | 1.545 | 1.558 | 1.583 | 1.608 | 1.632 | 1.656 | 1.679 | 1.691 | 1.724 | 1.745 | 1.767 | 1.787 | 1.808 | 1.828 | 1.847 | 1.866 | 1.886 | 1.903 | 1.921 |
| 84 | | 1.466 | 1.492 | 1.518 | 1.531 | 1.543 | 1.568 | 1.592 | 1.616 | 1.639 | 1.662 | 1.684 | 1.706 | 1.727 | 1.748 | 1.768 | 1.788 | 1.808 | 1.827 | 1.846 | 1.865 | 1.883 | 1.901 |
| 23 | $\frac{\bar{h}}{t_S}$ | 3.903 | 4.434 | 4.984 | 5.265 | 5.550 | 6.131 | 6.725 | 7.331 | 7.946 | 8.571 | 9.205 | 9.845 | 10.49 | 11.15 | 11.80 | 12.47 | 13.14 | 13.81 | 14.49 | 15.17 | 15.85 | 16.54 |
| 24 | | 3.869 | 4.396 | 4.943 | 5.222 | 5.505 | 6.084 | 6.674 | 7.278 | 7.890 | 8.511 | 9.143 | 9.781 | 10.43 | 11.08 | 11.73 | 12.40 | 13.06 | 13.74 | 14.41 | 15.09 | 15.77 | 16.46 |
| 25 | | 3.836 | 4.359 | 4.902 | 5.180 | 5.462 | 6.037 | 6.624 | 7.225 | 7.834 | 8.454 | 9.083 | 9.719 | 10.36 | 11.01 | 11.67 | 12.33 | 12.99 | 13.66 | 14.33 | 15.01 | 15.69 | 16.38 |
| 26 | | 3.803 | 4.323 | 4.862 | 5.139 | 5.419 | 5.991 | 6.575 | 7.173 | 7.780 | 8.397 | 9.023 | 9.657 | 10.30 | 10.94 | 11.60 | 12.26 | 12.92 | 13.59 | 14.26 | 14.93 | 15.61 | 16.29 |
| 27 | | 3.770 | 4.287 | 4.823 | 5.098 | 5.377 | 5.945 | 6.527 | 7.122 | 7.726 | 8.340 | 8.965 | 9.596 | 10.23 | 10.88 | 11.53 | 12.19 | 12.85 | 13.51 | 14.18 | 14.86 | 15.53 | 16.21 |
| 28 | | 3.739 | 4.252 | 4.785 | 5.058 | 5.335 | 5.901 | 6.480 | 7.072 | 7.674 | 8.285 | 8.907 | 9.535 | 10.17 | 10.81 | 11.46 | 12.12 | 12.78 | 13.44 | 14.11 | 14.78 | 15.46 | 16.13 |
| 29 | | 3.708 | 4.218 | 4.747 | 5.019 | 5.294 | 5.857 | 6.433 | 7.022 | 7.621 | 8.230 | 8.849 | 9.476 | 10.11 | 10.75 | 11.40 | 12.06 | 12.71 | 13.37 | 14.03 | 14.70 | 15.38 | 16.06 |
| 30 | | 3.677 | 4.184 | 4.710 | 4.980 | 5.254 | 5.814 | 6.387 | 6.973 | 7.570 | 8.176 | 8.793 | 9.417 | 10.05 | 10.69 | 11.33 | 11.98 | 12.64 | 13.30 | 13.96 | 14.63 | 15.30 | 15.98 |
| 31 | | 3.647 | 4.151 | 4.674 | 4.942 | 5.215 | 5.772 | 6.342 | 6.925 | 7.519 | 8.123 | 8.738 | 9.359 | 9.989 | 10.62 | 11.27 | 11.92 | 12.57 | 13.23 | 13.89 | 14.56 | 15.22 | 15.90 |
| 32 | | 3.618 | 4.118 | 4.638 | 4.905 | 5.176 | 5.730 | 6.297 | 6.878 | 7.469 | 8.071 | 8.683 | 9.302 | 9.929 | 10.56 | 11.20 | 11.85 | 12.50 | 13.16 | 13.82 | 14.48 | 15.15 | 15.83 |
| 33 | | 3.589 | 4.086 | 4.603 | 4.869 | 5.138 | 5.689 | 6.253 | 6.831 | 7.420 | 8.019 | 8.628 | 9.245 | 9.870 | 10.50 | 11.14 | 11.78 | 12.39 | 13.09 | 13.75 | 14.41 | 15.08 | 15.75 |
| 34 | | 3.561 | 4.055 | 4.569 | 4.832 | 5.100 | 5.648 | 6.210 | 6.786 | 7.371 | 7.968 | 8.575 | 9.190 | 9.812 | 10.44 | 11.08 | 11.72 | 12.37 | 13.02 | 13.68 | 14.34 | 15.01 | 15.68 |
| 35 | | 3.533 | 4.024 | 4.535 | 4.797 | 5.063 | 5.609 | 6.168 | 6.740 | 7.324 | 7.918 | 8.522 | 9.135 | 9.755 | 10.38 | 11.02 | 11.66 | 12.31 | 12.95 | 13.61 | 14.27 | 14.93 | 15.60 |
| 36 | | 3.506 | 3.993 | 4.501 | 4.762 | 5.027 | 5.569 | 6.126 | 6.696 | 7.277 | 7.868 | 8.470 | 9.080 | 9.699 | 10.32 | 10.96 | 11.59 | 12.24 | 12.89 | 13.54 | 14.20 | 14.86 | 15.53 |
| 37 | | 3.479 | 3.964 | 4.469 | 4.728 | 4.991 | 5.531 | 6.084 | 6.652 | 7.230 | 7.819 | 8.419 | 9.026 | 9.643 | 10.27 | 10.90 | 11.53 | 12.17 | 12.82 | 13.47 | 14.13 | 14.79 | 15.46 |
| 38 | | 3.453 | 3.934 | 4.436 | 4.694 | 4.956 | 5.493 | 6.044 | 6.608 | 7.184 | 7.770 | 8.368 | 8.973 | 9.587 | 10.21 | 10.84 | 11.47 | 12.11 | 12.76 | 13.41 | 14.06 | 14.72 | 15.38 |
| 39 | | 3.427 | 3.905 | 4.404 | 4.661 | 4.922 | 5.455 | 6.003 | 6.565 | 7.139 | 7.723 | 8.318 | 8.921 | 9.533 | 10.15 | 10.78 | 11.41 | 12.05 | 12.69 | 13.34 | 13.99 | 14.65 | 15.31 |
| 40 | | 3.402 | 3.877 | 4.373 | 4.628 | 4.887 | 5.418 | 5.964 | 6.523 | 7.094 | 7.676 | 8.269 | 8.870 | 9.479 | 10.10 | 10.72 | 11.35 | 11.99 | 12.63 | 13.27 | 13.93 | 14.58 | 15.24 |

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TABLE 5.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 0.79;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 17.17;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_B}{t_W} = 0.8\frac{b_W}{t_W} + 16.67;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.82;\ \frac{p}{t_S} = 12.30\right]$ - Concluded

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | | 3.352 | 3.822 | 4.312 | 4.564 | 4.821 | 5.346 | 5.886 | 6.441 | 7.007 | 7.583 | 8.171 | 8.768 | 9.373 | 9.985 | 10.61 | 11.23 | 11.86 | 12.50 | 13.15 | 13.79 | 14.45 | 15.10 |
| 44 | | 3.305 | 3.768 | 4.253 | 4.502 | 4.756 | 5.276 | 5.811 | 6.360 | 6.921 | 7.493 | 8.077 | 8.669 | 9.270 | 9.877 | 10.49 | 11.12 | 11.75 | 12.38 | 13.02 | 13.66 | 14.31 | 14.97 |
| 46 | | 3.258 | 3.716 | 4.196 | 4.442 | 4.693 | 5.208 | 5.742 | 6.282 | 6.838 | 7.405 | 7.984 | 8.572 | 9.169 | 9.772 | 10.38 | 11.00 | 11.63 | 12.26 | 12.90 | 13.53 | 14.18 | 14.83 |
| 48 | | 3.214 | 3.666 | 4.140 | 4.384 | 4.632 | 5.142 | 5.667 | 6.206 | 6.757 | 7.320 | 7.894 | 8.478 | 9.070 | 9.669 | 10.28 | 10.89 | 11.51 | 12.14 | 12.77 | 13.41 | 14.06 | 14.70 |
| 50 | | 3.170 | 3.618 | 4.086 | 4.327 | 4.573 | 5.078 | 5.597 | 6.132 | 6.678 | 7.236 | 7.806 | 8.385 | 8.973 | 9.569 | 10.17 | 10.78 | 11.40 | 12.03 | 12.65 | 13.29 | 13.93 | 14.57 |
| 52 | | 3.128 | 3.570 | 4.033 | 4.272 | 4.516 | 5.015 | 5.530 | 6.059 | 6.601 | 7.155 | 7.720 | 8.295 | 8.879 | 9.470 | 10.07 | 10.68 | 11.29 | 11.91 | 12.54 | 13.17 | 13.81 | 14.45 |
| 54 | | 3.088 | 3.524 | 3.983 | 4.219 | 4.460 | 4.954 | 5.464 | 5.989 | 6.526 | 7.075 | 7.636 | 8.207 | 8.787 | 9.374 | 9.970 | 10.57 | 11.18 | 11.80 | 12.42 | 13.05 | 13.69 | 14.32 |
| 56 | | 3.048 | 3.480 | 3.933 | 4.167 | 4.405 | 4.895 | 5.400 | 5.920 | 6.453 | 6.998 | 7.555 | 8.121 | 8.697 | 9.280 | 9.872 | 10.47 | 11.08 | 11.69 | 12.31 | 12.94 | 13.57 | 14.20 |
| 58 | $\frac{\bar{h}}{t_S}$ | 2.996 | 3.437 | 3.885 | 4.116 | 4.352 | 4.837 | 5.338 | 5.853 | 6.382 | 6.922 | 7.475 | 8.036 | 8.608 | 9.188 | 9.776 | 10.37 | 10.98 | 11.59 | 12.20 | 12.82 | 13.45 | 14.08 |
| 60 | | 2.973 | 3.395 | 3.838 | 4.067 | 4.301 | 4.781 | 5.277 | 5.788 | 6.312 | 6.848 | 7.396 | 7.954 | 8.522 | 9.127 | 9.682 | 10.28 | 10.87 | 11.48 | 12.09 | 12.71 | 13.33 | 13.96 |
| 63 | | 2.919 | 3.334 | 3.771 | 3.996 | 4.226 | 4.699 | 5.188 | 5.693 | 6.210 | 6.740 | 7.282 | 7.833 | 8.395 | 8.965 | 9.544 | 10.13 | 10.73 | 11.33 | 11.93 | 12.55 | 13.17 | 13.79 |
| 66 | | 2.868 | 3.276 | 3.705 | 3.928 | 4.154 | 4.621 | 5.103 | 5.601 | 6.112 | 6.635 | 7.171 | 7.717 | 8.273 | 8.837 | 9.411 | 9.993 | 10.58 | 11.18 | 11.78 | 12.39 | 13.00 | 13.62 |
| 69 | | 2.819 | 3.220 | 3.643 | 3.862 | 4.085 | 4.545 | 5.021 | 5.513 | 6.017 | 6.534 | 7.064 | 7.604 | 8.155 | 8.713 | 9.281 | 9.858 | 10.44 | 11.03 | 11.63 | 12.23 | 12.84 | 13.46 |
| 72 | | 2.772 | 3.167 | 3.583 | 3.798 | 4.019 | 4.472 | 4.942 | 5.427 | 5.928 | 6.437 | 6.961 | 7.495 | 8.039 | 8.592 | 9.155 | 9.726 | 10.30 | 10.89 | 11.48 | 12.08 | 12.69 | 13.30 |
| 75 | | 2.726 | 3.115 | 3.525 | 3.737 | 3.954 | 4.402 | 4.865 | 5.344 | 5.837 | 6.342 | 6.860 | 7.389 | 7.928 | 8.475 | 9.032 | 9.599 | 10.17 | 10.75 | 11.34 | 11.93 | 12.53 | 13.14 |
| 78 | | 2.683 | 3.065 | 3.469 | 3.679 | 3.893 | 4.334 | 4.791 | 5.264 | 5.751 | 6.250 | 6.763 | 7.288 | 7.819 | 8.361 | 8.914 | 9.475 | 10.04 | 10.62 | 11.20 | 11.79 | 12.39 | 12.99 |
| 81 | | 2.641 | 3.018 | 3.416 | 3.622 | 3.833 | 4.268 | 4.720 | 5.187 | 5.668 | 6.162 | 6.711 | 7.186 | 7.714 | 8.251 | 8.798 | 9.354 | 9.917 | 10.49 | 11.07 | 11.65 | 12.24 | 12.84 |
| 84 | | 2.600 | 2.971 | 3.364 | 3.567 | 3.775 | 4.206 | 4.651 | 5.112 | 5.588 | 6.076 | 6.577 | 7.089 | 7.612 | 8.144 | 8.685 | 9.236 | 9.794 | 10.36 | 10.93 | 11.51 | 12.10 | 12.69 |
| 23 | | 5.390 | 6.064 | 6.741 | 7.081 | 7.418 | 8.095 | 8.773 | 9.449 | 10.13 | 10.80 | 11.47 | 12.15 | 12.82 | 13.49 | 14.16 | 14.83 | 15.50 | 16.16 | 16.83 | 17.50 | 18.16 | 18.82 |
| 24 | | 5.374 | 6.047 | 6.723 | 7.062 | 7.401 | 8.078 | 8.754 | 9.432 | 10.11 | 10.78 | 11.46 | 12.13 | 12.80 | 13.48 | 14.15 | 14.81 | 15.48 | 16.15 | 16.82 | 17.48 | 18.15 | 18.81 |
| 25 | | 5.357 | 6.023 | 6.706 | 7.044 | 7.383 | 8.060 | 8.737 | 9.414 | 10.09 | 10.77 | 11.44 | 12.11 | 12.79 | 13.46 | 14.13 | 14.80 | 15.47 | 16.14 | 16.80 | 17.47 | 18.13 | 18.80 |
| 26 | | 5.342 | 6.014 | 6.689 | 7.027 | 7.365 | 8.042 | 8.719 | 9.396 | 10.07 | 10.75 | 11.42 | 12.10 | 12.77 | 13.44 | 14.11 | 14.78 | 15.45 | 16.12 | 16.79 | 17.45 | 18.12 | 18.78 |
| 27 | | 5.325 | 5.997 | 6.671 | 7.009 | 7.347 | 8.024 | 8.701 | 9.378 | 10.05 | 10.73 | 11.40 | 12.08 | 12.75 | 13.43 | 14.10 | 14.77 | 15.44 | 16.10 | 16.77 | 17.44 | 18.10 | 18.76 |
| 28 | | 5.309 | 5.980 | 6.654 | 6.992 | 7.330 | 8.007 | 8.683 | 9.360 | 10.04 | 10.71 | 11.39 | 12.06 | 12.74 | 13.41 | 14.08 | 14.75 | 15.42 | 16.09 | 16.76 | 17.42 | 18.09 | 18.75 |
| 29 | | 5.293 | 5.963 | 6.637 | 6.974 | 7.312 | 7.989 | 8.665 | 9.342 | 10.02 | 10.69 | 11.37 | 12.04 | 12.72 | 13.39 | 14.06 | 14.73 | 15.40 | 16.07 | 16.74 | 17.41 | 18.07 | 18.74 |
| 30 | | 5.277 | 5.947 | 6.620 | 6.957 | 7.295 | 7.971 | 8.647 | 9.324 | 10.00 | 10.68 | 11.35 | 12.03 | 12.70 | 13.37 | 14.05 | 14.72 | 15.39 | 16.06 | 16.72 | 17.39 | 18.06 | 18.72 |
| 31 | | 5.261 | 5.930 | 6.603 | 6.939 | 7.279 | 7.953 | 8.629 | 9.306 | 9.983 | 10.66 | 11.33 | 12.01 | 12.68 | 13.36 | 14.03 | 14.70 | 15.37 | 16.04 | 16.71 | 17.38 | 18.04 | 18.71 |
| 32 | | 5.245 | 5.914 | 6.586 | 6.922 | 7.260 | 7.935 | 8.612 | 9.288 | 9.964 | 10.64 | 11.32 | 11.99 | 12.67 | 13.34 | 14.01 | 14.68 | 15.35 | 16.02 | 16.69 | 17.36 | 18.03 | 18.69 |
| 33 | | 5.230 | 5.897 | 6.569 | 6.905 | 7.242 | 7.918 | 8.694 | 9.270 | 9.946 | 10.62 | 11.30 | 11.97 | 12.65 | 13.32 | 13.99 | 14.67 | 15.33 | 16.01 | 16.68 | 17.34 | 18.01 | 18.68 |
| 34 | | 5.214 | 5.881 | 6.552 | 6.888 | 7.225 | 7.900 | 8.576 | 9.252 | 9.928 | 10.60 | 11.28 | 11.95 | 12.63 | 13.30 | 13.98 | 14.65 | 15.32 | 15.99 | 16.66 | 17.33 | 18.00 | 18.66 |
| 35 | | 5.198 | 5.865 | 6.535 | 6.871 | 7.208 | 7.882 | 8.558 | 9.234 | 9.910 | 10.59 | 11.26 | 11.94 | 12.61 | 13.29 | 13.96 | 14.63 | 15.30 | 15.97 | 16.64 | 17.31 | 17.98 | 18.65 |
| 36 | | 5.183 | 5.849 | 6.518 | 6.854 | 7.191 | 7.865 | 8.540 | 9.216 | 9.892 | 10.57 | 11.24 | 11.92 | 12.59 | 13.27 | 13.94 | 14.61 | 15.29 | 15.96 | 16.63 | 17.30 | 17.96 | 18.63 |
| 37 | | 5.168 | 5.833 | 6.502 | 6.837 | 7.174 | 7.847 | 8.522 | 9.198 | 9.874 | 10.55 | 11.23 | 11.90 | 12.58 | 13.25 | 13.93 | 14.60 | 15.27 | 15.94 | 16.61 | 17.28 | 17.95 | 18.62 |
| 38 | | 5.152 | 5.817 | 6.485 | 6.820 | 7.156 | 7.830 | 8.504 | 9.180 | 9.856 | 10.53 | 11.21 | 11.88 | 12.56 | 13.23 | 13.91 | 14.58 | 15.25 | 15.92 | 16.59 | 17.26 | 17.93 | 18.60 |
| 39 | | 5.137 | 5.801 | 6.468 | 6.803 | 7.139 | 7.812 | 8.487 | 9.162 | 9.838 | 10.51 | 11.19 | 11.86 | 12.54 | 13.21 | 13.89 | 14.56 | 15.23 | 15.91 | 16.58 | 17.25 | 17.92 | 18.58 |
| 40 | | 5.122 | 5.785 | 6.452 | 6.786 | 7.122 | 7.795 | 8.469 | 9.144 | 9.820 | 10.50 | 11.17 | 11.85 | 12.52 | 13.20 | 13.87 | 14.54 | 15.22 | 15.89 | 16.56 | 17.23 | 17.90 | 18.57 |
| 42 | $\frac{\rho}{t_S}$ | 5.093 | 5.753 | 6.419 | 6.753 | 7.088 | 7.760 | 8.433 | 9.108 | 9.783 | 10.46 | 11.13 | 11.81 | 12.49 | 13.16 | 13.83 | 14.51 | 15.18 | 15.85 | 16.53 | 17.20 | 17.87 | 18.53 |
| 44 | | 5.063 | 5.722 | 6.386 | 6.720 | 7.055 | 7.726 | 8.398 | 9.072 | 9.747 | 10.42 | 11.10 | 11.77 | 12.45 | 13.12 | 13.80 | 14.47 | 15.15 | 15.82 | 16.49 | 17.16 | 17.83 | 18.50 |
| 46 | | 5.034 | 5.691 | 6.354 | 6.687 | 7.021 | 7.691 | 8.361 | 9.037 | 9.711 | 10.39 | 11.06 | 11.74 | 12.41 | 13.09 | 13.76 | 14.44 | 15.11 | 15.78 | 16.46 | 17.13 | 17.80 | 18.47 |
| 48 | | 5.005 | 5.661 | 6.322 | 6.655 | 6.988 | 7.657 | 8.328 | 9.011 | 9.675 | 10.35 | 11.02 | 11.70 | 12.38 | 13.05 | 13.73 | 14.40 | 15.07 | 15.75 | 16.42 | 17.09 | 17.76 | 18.43 |
| 50 | | 4.977 | 5.635 | 6.291 | 6.622 | 6.955 | 7.623 | 8.293 | 8.965 | 9.640 | 10.31 | 10.99 | 11.66 | 12.34 | 13.01 | 13.69 | 14.36 | 15.04 | 15.71 | 16.38 | 17.06 | 17.73 | 18.40 |
| 52 | | 4.949 | 5.601 | 6.259 | 6.591 | 6.923 | 7.590 | 8.259 | 8.930 | 9.604 | 10.28 | 10.95 | 11.63 | 12.30 | 12.98 | 13.65 | 14.33 | 15.00 | 15.68 | 16.35 | 17.02 | 17.69 | 18.36 |
| 54 | | 4.921 | 5.572 | 6.229 | 6.559 | 6.891 | 7.556 | 8.225 | 8.896 | 9.568 | 10.24 | 10.92 | 11.59 | 12.27 | 12.94 | 13.62 | 14.29 | 14.97 | 15.64 | 16.31 | 16.99 | 17.66 | 18.33 |
| 56 | | 4.894 | 5.543 | 6.198 | 6.528 | 6.859 | 7.523 | 8.191 | 8.861 | 9.533 | 10.21 | 10.88 | 11.55 | 12.23 | 12.90 | 13.58 | 14.25 | 14.93 | 15.60 | 16.28 | 16.95 | 17.62 | 18.29 |
| 58 | | 4.860 | 5.514 | 6.168 | 6.497 | 6.827 | 7.490 | 8.157 | 8.826 | 9.498 | 10.17 | 10.84 | 11.52 | 12.19 | 12.87 | 13.54 | 14.22 | 14.89 | 15.57 | 16.24 | 16.91 | 17.59 | 18.26 |
| 60 | | 4.841 | 5.486 | 6.138 | 6.466 | 6.796 | 7.458 | 8.124 | 8.792 | 9.463 | 10.14 | 10.81 | 11.48 | 12.16 | 12.84 | 13.51 | 14.18 | 14.86 | 15.53 | 16.20 | 16.88 | 17.55 | 18.22 |
| 63 | | 4.802 | 5.444 | 6.093 | 6.431 | 6.749 | 7.410 | 8.074 | 8.741 | 9.410 | 10.08 | 10.75 | 11.43 | 12.10 | 12.78 | 13.45 | 14.13 | 14.80 | 15.47 | 16.15 | 16.82 | 17.50 | 18.17 |
| 66 | | 4.763 | 5.403 | 6.050 | 6.376 | 6.704 | 7.362 | 8.025 | 8.690 | 9.359 | 10.03 | 10.70 | 11.37 | 12.05 | 12.72 | 13.40 | 14.07 | 14.74 | 15.42 | 16.09 | 16.77 | 17.44 | 18.11 |
| 69 | | 4.707 | 5.362 | 6.007 | 6.332 | 6.659 | 7.316 | 7.976 | 8.640 | 9.308 | 9.977 | 10.65 | 11.32 | 12.02 | 12.67 | 13.34 | 14.01 | 14.69 | 15.36 | 16.04 | 16.71 | 17.39 | 18.06 |
| 72 | | 4.689 | 5.323 | 5.965 | 6.289 | 6.615 | 7.269 | 7.928 | 8.591 | 9.258 | 9.925 | 10.59 | 11.26 | 11.94 | 12.61 | 13.29 | 13.96 | 14.63 | 15.31 | 15.98 | 16.66 | 17.33 | 18.03 |
| 75 | | 4.653 | 5.284 | 5.924 | 6.246 | 6.571 | 7.224 | 7.881 | 8.542 | 9.207 | 9.874 | 10.54 | 11.21 | 11.88 | 12.56 | 13.23 | 13.90 | 14.58 | 15.25 | 15.93 | 16.60 | 17.28 | 17.95 |
| 78 | | 4.618 | 5.246 | 5.883 | 6.205 | 6.528 | 7.179 | 7.835 | 8.494 | 9.157 | 9.823 | 10.49 | 11.16 | 11.83 | 12.50 | 13.18 | 13.85 | 14.52 | 15.20 | 15.87 | 16.55 | 17.22 | 17.89 |
| 81 | | 4.583 | 5.209 | 5.843 | 6.164 | 6.486 | 7.135 | 7.788 | 8.447 | 9.108 | 9.773 | 10.46 | 11.11 | 11.78 | 12.49 | 13.12 | 13.79 | 14.47 | 15.14 | 15.82 | 16.49 | 17.16 | 17.84 |
| 84 | | 4.550 | 5.172 | 5.804 | 6.110 | 6.445 | 7.091 | 7.743 | 8.399 | 9.060 | 9.723 | 10.44 | 11.06 | 11.73 | 12.40 | 13.07 | 13.74 | 14.41 | 15.09 | 15.76 | 16.44 | 17.11 | 17.78 |

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TABLE 6.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 1.00;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 15.75;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W},\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 15.25;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 3.13;\ \frac{p}{t_S} = 12.50\right]$

| $b_S/t_S$ \ $b_W/t_W$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | | 2.470 | 2.529 | 2.586 | 2.612 | 2.638 | 2.688 | 2.735 | 2.780 | 2.823 | 2.863 | 2.902 | 2.939 | 2.974 | 3.008 | 3.040 | 3.071 | 3.101 | 3.129 | 3.156 | 3.183 | 3.208 | 3.232 |
| 24 | | 2.443 | 2.502 | 2.558 | 2.584 | 2.610 | 2.660 | 2.707 | 2.754 | 2.795 | 2.836 | 2.874 | 2.911 | 2.947 | 2.981 | 3.013 | 3.044 | 3.074 | 3.102 | 3.130 | 3.156 | 3.182 | 3.206 |
| 25 | | 2.417 | 2.476 | 2.531 | 2.557 | 2.583 | 2.633 | 2.680 | 2.725 | 2.768 | 2.809 | 2.848 | 2.885 | 2.920 | 2.954 | 2.987 | 3.018 | 3.048 | 3.076 | 3.104 | 3.131 | 3.156 | 3.181 |
| 26 | | 2.392 | 2.450 | 2.506 | 2.532 | 2.557 | 2.607 | 2.654 | 2.699 | 2.742 | 2.783 | 2.821 | 2.859 | 2.894 | 2.928 | 2.961 | 2.992 | 3.022 | 3.051 | 3.079 | 3.106 | 3.131 | 3.156 |
| 27 | | 2.367 | 2.425 | 2.480 | 2.507 | 2.532 | 2.582 | 2.629 | 2.674 | 2.716 | 2.757 | 2.796 | 2.833 | 2.869 | 2.903 | 2.936 | 2.967 | 2.997 | 3.026 | 3.046 | 3.081 | 3.107 | 3.140 |
| 28 | | 2.344 | 2.402 | 2.456 | 2.482 | 2.508 | 2.557 | 2.605 | 2.649 | 2.692 | 2.732 | 2.771 | 2.809 | 2.844 | 2.878 | 2.911 | 2.943 | 2.973 | 3.002 | 3.030 | 3.057 | 3.083 | 3.108 |
| 29 | | 2.321 | 2.379 | 2.433 | 2.459 | 2.485 | 2.534 | 2.581 | 2.625 | 2.668 | 2.708 | 2.747 | 2.785 | 2.820 | 2.854 | 2.887 | 2.919 | 2.949 | 2.979 | 3.010 | 3.034 | 3.060 | 3.085 |
| 30 | | 2.299 | 2.356 | 2.410 | 2.436 | 2.462 | 2.511 | 2.557 | 2.602 | 2.644 | 2.685 | 2.724 | 2.761 | 2.797 | 2.831 | 2.864 | 2.896 | 2.920 | 2.956 | 2.984 | 3.011 | 3.037 | 3.063 |
| 31 | | 2.278 | 2.335 | 2.388 | 2.414 | 2.440 | 2.488 | 2.535 | 2.579 | 2.622 | 2.662 | 2.701 | 2.738 | 2.774 | 2.808 | 2.841 | 2.873 | 2.904 | 2.933 | 2.961 | 2.989 | 3.015 | 3.041 |
| 32 | | 2.258 | 2.314 | 2.367 | 2.393 | 2.418 | 2.467 | 2.513 | 2.557 | 2.600 | 2.640 | 2.679 | 2.716 | 2.752 | 2.786 | 2.819 | 2.851 | 2.882 | 2.911 | 2.939 | 2.967 | 2.993 | 3.019 |
| 33 | | 2.238 | 2.293 | 2.347 | 2.372 | 2.397 | 2.446 | 2.492 | 2.536 | 2.578 | 2.618 | 2.657 | 2.694 | 2.730 | 2.765 | 2.798 | 2.829 | 2.860 | 2.890 | 2.918 | 2.946 | 2.972 | 2.998 |
| 34 | | 2.218 | 2.274 | 2.327 | 2.352 | 2.377 | 2.425 | 2.471 | 2.515 | 2.557 | 2.597 | 2.636 | 2.673 | 2.709 | 2.743 | 2.776 | 2.808 | 2.839 | 2.868 | 2.897 | 2.925 | 2.951 | 2.977 |
| 35 | | 2.200 | 2.255 | 2.307 | 2.333 | 2.357 | 2.405 | 2.451 | 2.495 | 2.537 | 2.577 | 2.616 | 2.653 | 2.688 | 2.723 | 2.756 | 2.788 | 2.818 | 2.848 | 2.877 | 2.904 | 2.931 | 2.957 |
| 36 | | 2.182 | 2.236 | 2.288 | 2.314 | 2.338 | 2.386 | 2.431 | 2.475 | 2.517 | 2.557 | 2.596 | 2.633 | 2.668 | 2.703 | 2.736 | 2.767 | 2.798 | 2.828 | 2.856 | 2.884 | 2.911 | 2.937 |
| 37 | | 2.164 | 2.218 | 2.270 | 2.295 | 2.320 | 2.367 | 2.412 | 2.456 | 2.498 | 2.539 | 2.576 | 2.613 | 2.649 | 2.683 | 2.716 | 2.748 | 2.778 | 2.808 | 2.837 | 2.864 | 2.891 | 2.917 |
| 38 | | 2.147 | 2.201 | 2.252 | 2.277 | 2.302 | 2.349 | 2.394 | 2.437 | 2.479 | 2.519 | 2.557 | 2.594 | 2.629 | 2.664 | 2.697 | 2.728 | 2.759 | 2.789 | 2.818 | 2.845 | 2.872 | 2.898 |
| 39 | | 2.130 | 2.184 | 2.236 | 2.260 | 2.284 | 2.331 | 2.376 | 2.419 | 2.460 | 2.500 | 2.538 | 2.576 | 2.611 | 2.643 | 2.678 | 2.710 | 2.740 | 2.770 | 2.799 | 2.826 | 2.853 | 2.879 |
| 40 | $\bar{t}/t_S$ | 2.114 | 2.167 | 2.218 | 2.243 | 2.267 | 2.314 | 2.358 | 2.401 | 2.442 | 2.482 | 2.520 | 2.557 | 2.592 | 2.626 | 2.659 | 2.691 | 2.722 | 2.752 | 2.780 | 2.808 | 2.835 | 2.861 |
| 42 | | 2.084 | 2.136 | 2.186 | 2.210 | 2.234 | 2.280 | 2.324 | 2.367 | 2.408 | 2.447 | 2.485 | 2.522 | 2.557 | 2.586 | 2.624 | 2.655 | 2.686 | 2.716 | 2.744 | 2.772 | 2.799 | 2.826 |
| 44 | | 2.064 | 2.106 | 2.155 | 2.179 | 2.203 | 2.248 | 2.292 | 2.334 | 2.375 | 2.414 | 2.452 | 2.488 | 2.523 | 2.557 | 2.590 | 2.621 | 2.651 | 2.681 | 2.710 | 2.738 | 2.755 | 2.791 |
| 46 | | 2.027 | 2.078 | 2.126 | 2.150 | 2.173 | 2.218 | 2.261 | 2.303 | 2.343 | 2.382 | 2.420 | 2.456 | 2.491 | 2.524 | 2.557 | 2.588 | 2.619 | 2.648 | 2.677 | 2.705 | 2.732 | 2.758 |
| 48 | | 2.000 | 2.051 | 2.099 | 2.122 | 2.145 | 2.189 | 2.232 | 2.274 | 2.313 | 2.352 | 2.389 | 2.425 | 2.459 | 2.493 | 2.525 | 2.557 | 2.587 | 2.617 | 2.645 | 2.673 | 2.700 | 2.726 |
| 50 | | 1.976 | 2.025 | 2.072 | 2.095 | 2.118 | 2.162 | 2.204 | 2.245 | 2.285 | 2.323 | 2.360 | 2.395 | 2.430 | 2.463 | 2.495 | 2.526 | 2.557 | 2.586 | 2.615 | 2.642 | 2.669 | 2.695 |
| 52 | | 1.952 | 2.000 | 2.047 | 2.070 | 2.092 | 2.136 | 2.178 | 2.218 | 2.257 | 2.295 | 2.331 | 2.367 | 2.401 | 2.434 | 2.466 | 2.497 | 2.527 | 2.557 | 2.585 | 2.613 | 2.639 | 2.666 |
| 54 | | 1.929 | 1.977 | 2.023 | 2.046 | 2.068 | 2.111 | 2.152 | 2.192 | 2.231 | 2.268 | 2.304 | 2.340 | 2.373 | 2.406 | 2.438 | 2.469 | 2.499 | 2.528 | 2.557 | 2.584 | 2.611 | 2.637 |
| 56 | | 1.908 | 1.955 | 2.000 | 2.022 | 2.044 | 2.087 | 2.128 | 2.167 | 2.206 | 2.243 | 2.279 | 2.313 | 2.347 | 2.380 | 2.411 | 2.442 | 2.472 | 2.501 | 2.529 | 2.557 | 2.583 | 2.609 |
| 58 | | 1.887 | 1.934 | 1.979 | 2.000 | 2.022 | 2.064 | 2.104 | 2.143 | 2.181 | 2.218 | 2.254 | 2.288 | 2.322 | 2.354 | 2.385 | 2.416 | 2.446 | 2.475 | 2.503 | 2.530 | 2.557 | 2.582 |
| 60 | | 1.867 | 1.913 | 1.958 | 1.979 | 2.000 | 2.042 | 2.082 | 2.121 | 2.158 | 2.194 | 2.230 | 2.264 | 2.297 | 2.329 | 2.361 | 2.391 | 2.420 | 2.449 | 2.477 | 2.504 | 2.531 | 2.557 |
| 63 | | 1.840 | 1.884 | 1.928 | 1.949 | 1.970 | 2.010 | 2.050 | 2.088 | 2.125 | 2.161 | 2.186 | 2.229 | 2.262 | 2.294 | 2.325 | 2.355 | 2.384 | 2.413 | 2.440 | 2.467 | 2.494 | 2.519 |
| 66 | | 1.813 | 1.857 | 1.900 | 1.920 | 1.941 | 1.981 | 2.019 | 2.057 | 2.093 | 2.129 | 2.145 | 2.196 | 2.229 | 2.260 | 2.291 | 2.321 | 2.350 | 2.378 | 2.405 | 2.432 | 2.458 | 2.484 |
| 69 | | 1.789 | 1.832 | 1.873 | 1.894 | 1.914 | 1.953 | 1.991 | 2.028 | 2.064 | 2.098 | 2.132 | 2.165 | 2.197 | 2.228 | 2.259 | 2.288 | 2.317 | 2.345 | 2.372 | 2.399 | 2.425 | 2.450 |
| 72 | | 1.766 | 1.808 | 1.849 | 1.868 | 1.888 | 1.927 | 1.964 | 2.000 | 2.036 | 2.070 | 2.103 | 2.136 | 2.167 | 2.198 | 2.228 | 2.257 | 2.285 | 2.313 | 2.340 | 2.367 | 2.392 | 2.417 |
| 75 | | 1.744 | 1.785 | 1.825 | 1.845 | 1.864 | 1.902 | 1.938 | 1.974 | 2.009 | 2.043 | 2.076 | 2.108 | 2.139 | 2.169 | 2.199 | 2.227 | 2.256 | 2.283 | 2.310 | 2.336 | 2.361 | 2.386 |
| 78 | | 1.723 | 1.764 | 1.803 | 1.822 | 1.841 | 1.878 | 1.914 | 1.949 | 1.984 | 2.017 | 2.049 | 2.081 | 2.112 | 2.142 | 2.171 | 2.199 | 2.227 | 2.254 | 2.281 | 2.307 | 2.332 | 2.357 |
| 81 | | 1.704 | 1.743 | 1.782 | 1.801 | 1.819 | 1.856 | 1.891 | 1.926 | 1.959 | 1.992 | 2.024 | 2.055 | 2.086 | 2.115 | 2.144 | 2.172 | 2.200 | 2.227 | 2.253 | 2.279 | 2.304 | 2.328 |
| 84 | | 1.685 | 1.724 | 1.762 | 1.780 | 1.799 | 1.835 | 1.869 | 1.903 | 1.937 | 1.969 | 2.000 | 2.031 | 2.061 | 3.090 | 2.119 | 2.147 | 2.174 | 2.200 | 2.226 | 2.252 | 2.277 | 2.301 |
| 23 | | 5.557 | 6.325 | 7.116 | 7.511 | 7.927 | 8.754 | 9.597 | 10.45 | 11.32 | 12.20 | 13.08 | 13.98 | 14.88 | 15.79 | 16.70 | 17.62 | 18.54 | 19.47 | 20.40 | 21.34 | 22.28 | 23.22 |
| 24 | | 5.519 | 6.284 | 7.068 | 7.465 | 7.875 | 8.703 | 9.543 | 10.40 | 11.26 | 12.14 | 13.02 | 13.91 | 14.81 | 15.72 | 16.63 | 17.55 | 18.47 | 19.40 | 20.33 | 21.26 | 22.20 | 23.14 |
| 25 | | 5.481 | 6.242 | 7.022 | 7.419 | 7.824 | 8.653 | 9.490 | 10.34 | 11.20 | 12.07 | 12.96 | 13.85 | 14.74 | 15.65 | 16.56 | 17.47 | 18.39 | 19.30 | 20.25 | 21.18 | 22.12 | 23.06 |
| 26 | | 5.444 | 6.202 | 6.973 | 7.373 | 7.774 | 8.603 | 9.437 | 10.29 | 11.14 | 12.01 | 12.89 | 13.78 | 14.68 | 15.58 | 16.49 | 17.40 | 18.32 | 19.24 | 20.17 | 21.10 | 22.04 | 22.98 |
| 27 | | 5.408 | 6.162 | 6.927 | 7.328 | 7.726 | 8.554 | 9.385 | 10.23 | 11.09 | 11.95 | 12.83 | 13.72 | 14.61 | 15.51 | 16.42 | 17.33 | 18.25 | 19.17 | 20.10 | 21.03 | 21.96 | 22.90 |
| 28 | | 5.372 | 6.123 | 6.881 | 7.284 | 7.676 | 8.505 | 9.332 | 10.18 | 11.03 | 11.90 | 12.77 | 13.65 | 14.55 | 15.44 | 16.35 | 17.26 | 18.17 | 19.10 | 20.02 | 20.95 | 21.88 | 22.82 |
| 29 | | 5.336 | 6.084 | 6.836 | 7.241 | 7.628 | 8.457 | 9.282 | 10.12 | 10.97 | 11.84 | 12.71 | 13.59 | 14.48 | 15.38 | 16.28 | 17.19 | 18.10 | 19.02 | 19.94 | 20.87 | 21.80 | 22.74 |
| 30 | | 5.302 | 6.045 | 6.791 | 7.198 | 7.580 | 8.409 | 9.232 | 10.07 | 10.92 | 11.78 | 12.65 | 13.53 | 14.42 | 15.31 | 16.21 | 17.12 | 18.03 | 18.95 | 19.87 | 20.80 | 21.73 | 22.66 |
| 31 | $h/t_S$ | 5.267 | 6.008 | 6.747 | 7.155 | 7.533 | 8.362 | 9.183 | 10.02 | 10.86 | 11.72 | 12.59 | 13.47 | 14.35 | 15.25 | 16.14 | 17.05 | 17.96 | 18.88 | 19.80 | 20.73 | 21.65 | 22.58 |
| 32 | | 5.233 | 5.970 | 6.703 | 7.113 | 7.487 | 8.316 | 9.133 | 9.985 | 10.81 | 11.67 | 12.53 | 13.41 | 14.29 | 15.18 | 16.08 | 16.98 | 17.89 | 18.80 | 19.72 | 20.65 | 21.57 | 22.50 |
| 33 | | 5.200 | 5.934 | 6.660 | 7.072 | 7.441 | 8.270 | 9.085 | 9.914 | 10.76 | 11.61 | 12.47 | 13.35 | 14.23 | 15.12 | 16.01 | 16.91 | 17.82 | 18.73 | 19.65 | 20.57 | 21.50 | 22.43 |
| 34 | | 5.167 | 5.897 | 6.618 | 7.031 | 7.395 | 8.224 | 9.037 | 9.863 | 10.70 | 11.55 | 12.42 | 13.29 | 14.17 | 15.05 | 15.95 | 16.85 | 17.51 | 18.66 | 19.58 | 20.50 | 21.42 | 22.35 |
| 35 | | 5.134 | 5.861 | 6.576 | 6.990 | 7.351 | 8.179 | 8.989 | 9.813 | 10.66 | 11.50 | 12.36 | 13.23 | 14.11 | 14.99 | 15.88 | 16.78 | 17.68 | 18.59 | 19.51 | 20.42 | 21.35 | 22.27 |
| 36 | | 5.102 | 5.826 | 6.534 | 6.950 | 7.306 | 8.135 | 8.942 | 9.764 | 10.60 | 11.44 | 12.30 | 13.17 | 14.04 | 14.93 | 15.82 | 16.71 | 17.61 | 18.52 | 19.43 | 20.35 | 21.27 | 22.20 |
| 37 | | 5.071 | 5.791 | 6.494 | 6.911 | 7.263 | 8.092 | 8.896 | 9.714 | 10.55 | 11.39 | 12.25 | 13.11 | 13.98 | 14.86 | 15.76 | 16.65 | 17.55 | 18.45 | 19.36 | 20.28 | 21.20 | 22.12 |
| 38 | | 5.039 | 5.757 | 6.453 | 6.872 | 7.219 | 8.048 | 8.850 | 9.666 | 10.50 | 11.34 | 12.19 | 13.05 | 13.92 | 14.80 | 15.69 | 16.58 | 17.48 | 18.38 | 19.27 | 20.21 | 21.13 | 22.05 |
| 39 | | 5.009 | 5.723 | 6.413 | 6.833 | 7.177 | 8.005 | 8.804 | 9.618 | 10.45 | 11.28 | 12.13 | 13.00 | 13.87 | 14.74 | 15.63 | 16.52 | 17.41 | 18.32 | 19.22 | 20.14 | 21.06 | 21.98 |
| 40 | | 4.978 | 5.689 | 6.374 | 6.795 | 7.135 | 7.963 | 8.759 | 9.570 | 10.40 | 11.23 | 12.08 | 12.94 | 13.81 | 14.68 | 15.56 | 16.45 | 17.35 | 18.25 | 19.16 | 20.07 | 20.98 | 21.90 |

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TABLE 6.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 1.00;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 15.75;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 15.25;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 3.13;\ \frac{p}{t_S} = 12.50\right]$ - Concluded

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | $\frac{h}{t_S}$ | 4.919 | 5.624 | 6.297 | 6.721 | 7.052 | 7.880 | 8.671 | 9.477 | 10.30 | 11.13 | 11.97 | 12.83 | 13.69 | 14.56 | 15.44 | 16.33 | 17.22 | 18.12 | 19.02 | 19.93 | 20.84 | 21.76 |
| 44 | | 4.861 | 5.559 | 6.221 | 6.648 | 6.971 | 7.799 | 8.584 | 9.385 | 10.20 | 11.03 | 11.87 | 12.72 | 13.58 | 14.44 | 15.32 | 16.20 | 17.09 | 17.98 | 18.88 | 19.79 | 20.77 | 21.61 |
| 46 | | 4.804 | 5.497 | 6.148 | 6.576 | 6.892 | 7.719 | 8.499 | 9.295 | 10.11 | 10.93 | 11.76 | 12.61 | 13.46 | 14.33 | 15.20 | 16.08 | 16.96 | 17.85 | 18.75 | 19.65 | 20.56 | 21.47 |
| 48 | | 4.749 | 5.436 | 6.076 | 6.507 | 6.814 | 7.641 | 8.416 | 9.207 | 10.01 | 10.83 | 11.66 | 12.50 | 13.35 | 14.21 | 15.08 | 15.96 | 16.84 | 17.73 | 18.62 | 19.52 | 20.42 | 21.33 |
| 50 | | 4.696 | 5.376 | 6.005 | 6.439 | 6.739 | 7.565 | 8.334 | 9.121 | 9.921 | 10.74 | 11.56 | 12.40 | 13.25 | 14.10 | 14.97 | 15.84 | 16.72 | 17.60 | 18.49 | 19.39 | 20.29 | 21.19 |
| 52 | | 4.643 | 5.318 | 5.937 | 6.372 | 6.665 | 7.490 | 8.256 | 9.036 | 9.832 | 10.64 | 11.46 | 12.30 | 13.14 | 13.99 | 14.85 | 15.72 | 16.59 | 17.48 | 18.36 | 19.26 | 20.16 | 21.05 |
| 54 | | 4.592 | 5.261 | 5.870 | 6.307 | 6.592 | 7.417 | 8.177 | 8.953 | 9.744 | 10.55 | 11.37 | 12.20 | 13.04 | 13.88 | 14.74 | 15.60 | 16.48 | 17.35 | 18.24 | 19.13 | 20.02 | 20.92 |
| 56 | | 4.543 | 5.206 | 5.804 | 6.244 | 6.521 | 7.346 | 8.100 | 8.872 | 9.658 | 10.46 | 11.27 | 12.10 | 12.93 | 13.78 | 14.63 | 15.49 | 16.36 | 17.23 | 18.12 | 19.00 | 19.89 | 20.79 |
| 58 | | 4.494 | 5.152 | 5.740 | 6.181 | 6.452 | 7.275 | 8.025 | 8.792 | 9.574 | 10.37 | 11.18 | 12.00 | 12.83 | 13.67 | 14.52 | 15.38 | 16.24 | 17.12 | 17.99 | 18.88 | 19.77 | 20.66 |
| 60 | | 4.447 | 5.099 | 5.677 | 6.120 | 6.384 | 7.207 | 7.951 | 8.714 | 9.491 | 10.28 | 11.09 | 11.90 | 12.73 | 13.57 | 14.41 | 15.27 | 16.13 | 17.00 | 17.87 | 18.75 | 19.64 | 20.53 |
| 63 | | 4.378 | 5.022 | 5.585 | 6.031 | 6.285 | 7.106 | 7.844 | 8.599 | 9.369 | 10.15 | 11.00 | 11.76 | 12.59 | 13.42 | 14.26 | 15.10 | 15.96 | 16.83 | 17.70 | 18.57 | 19.45 | 20.34 |
| 66 | | 4.311 | 4.947 | 5.497 | 5.945 | 6.189 | 7.009 | 7.739 | 8.487 | 9.251 | 10.03 | 10.91 | 11.63 | 12.44 | 13.27 | 14.10 | 14.95 | 15.80 | 16.66 | 17.52 | 18.39 | 19.27 | 20.16 |
| 69 | | 4.247 | 4.875 | 5.411 | 5.862 | 6.096 | 6.914 | 7.637 | 8.379 | 9.136 | 9.908 | 10.69 | 11.49 | 12.30 | 13.12 | 13.95 | 14.79 | 15.64 | 16.49 | 17.35 | 18.22 | 19.09 | 19.97 |
| 72 | | 4.184 | 4.805 | 5.328 | 5.781 | 6.005 | 6.822 | 7.538 | 8.273 | 9.024 | 9.790 | 10.57 | 11.36 | 12.17 | 12.98 | 13.80 | 14.64 | 15.48 | 16.33 | 17.18 | 18.05 | 18.91 | 19.79 |
| 75 | | 4.124 | 4.737 | 5.247 | 5.702 | 5.917 | 6.733 | 7.442 | 8.170 | 8.914 | 9.674 | 10.45 | 11.23 | 12.08 | 12.84 | 13.66 | 14.49 | 15.33 | 16.17 | 17.02 | 17.88 | 18.74 | 19.62 |
| 78 | | 4.066 | 4.671 | 5.169 | 5.626 | 5.832 | 6.646 | 7.349 | 8.070 | 8.808 | 9.561 | 10.33 | 11.11 | 11.90 | 12.71 | 13.52 | 14.34 | 15.17 | 16.01 | 16.86 | 17.71 | 18.58 | 19.44 |
| 81 | | 4.009 | 4.608 | 5.092 | 5.552 | 5.749 | 6.562 | 7.258 | 7.972 | 8.704 | 9.451 | 10.21 | 10.99 | 11.78 | 12.57 | 13.38 | 14.20 | 15.03 | 15.86 | 16.70 | 17.55 | 19.41 | 19.27 |
| 84 | | 3.955 | 4.546 | 5.019 | 5.480 | 5.669 | 6.480 | 7.169 | 7.877 | 8.603 | 9.344 | 10.10 | 10.87 | 11.65 | 12.44 | 13.25 | 14.06 | 14.88 | 15.71 | 16.55 | 17.39 | 18.25 | 19.10 |
| 23 | $\frac{p}{t_S}$ | 7.141 | 8.007 | 8.872 | 9.310 | 9.736 | 10.60 | 11.46 | 12.31 | 13.17 | 14.02 | 14.86 | 15.71 | 16.56 | 17.40 | 18.24 | 19.08 | 19.91 | 20.75 | 21.58 | 22.41 | 23.24 | 24.07 |
| 24 | | 7.127 | 7.993 | 8.861 | 9.297 | 9.724 | 10.58 | 11.44 | 12.30 | 13.15 | 14.01 | 14.85 | 15.70 | 16.55 | 17.39 | 18.23 | 19.07 | 19.90 | 20.74 | 21.57 | 22.40 | 23.23 | 24.06 |
| 25 | | 7.114 | 7.980 | 8.849 | 9.283 | 9.713 | 10.57 | 11.43 | 12.29 | 13.14 | 13.99 | 14.84 | 15.69 | 16.54 | 17.38 | 18.22 | 19.06 | 19.90 | 20.73 | 21.57 | 22.40 | 23.23 | 24.06 |
| 26 | | 7.100 | 7.966 | 8.838 | 9.269 | 9.702 | 10.56 | 11.42 | 12.27 | 13.13 | 13.98 | 14.83 | 15.68 | 16.52 | 17.37 | 18.21 | 19.05 | 19.89 | 20.72 | 21.56 | 22.39 | 23.22 | 24.05 |
| 27 | | 7.086 | 7.953 | 8.826 | 9.256 | 9.691 | 10.54 | 11.40 | 12.26 | 13.12 | 13.97 | 14.82 | 15.67 | 16.52 | 17.36 | 18.20 | 19.04 | 19.88 | 20.72 | 21.55 | 22.38 | 23.22 | 24.05 |
| 28 | | 7.073 | 7.939 | 8.815 | 9.242 | 9.679 | 10.53 | 11.39 | 12.25 | 13.11 | 13.96 | 14.81 | 15.66 | 16.50 | 17.35 | 18.19 | 19.03 | 19.87 | 20.71 | 21.54 | 22.38 | 23.21 | 24.04 |
| 29 | | 7.059 | 7.925 | 8.803 | 9.228 | 9.668 | 10.52 | 11.38 | 12.24 | 13.09 | 13.95 | 14.80 | 15.65 | 16.49 | 17.34 | 18.18 | 19.02 | 19.86 | 20.70 | 21.54 | 22.37 | 23.20 | 24.03 |
| 30 | | 7.046 | 7.911 | 8.791 | 9.214 | 9.656 | 10.50 | 11.36 | 12.22 | 13.08 | 13.93 | 14.79 | 15.64 | 16.48 | 17.33 | 18.17 | 19.01 | 19.85 | 20.69 | 21.53 | 22.36 | 23.20 | 24.03 |
| 31 | | 7.032 | 7.898 | 8.774 | 9.200 | 9.644 | 10.49 | 11.35 | 12.21 | 13.07 | 13.92 | 14.77 | 15.62 | 16.47 | 17.32 | 18.16 | 19.00 | 19.84 | 20.68 | 21.52 | 22.36 | 23.19 | 24.02 |
| 32 | | 7.019 | 7.884 | 8.766 | 9.187 | 9.632 | 10.48 | 11.34 | 12.20 | 13.06 | 13.91 | 14.76 | 15.61 | 16.46 | 17.31 | 18.15 | 19.00 | 19.84 | 20.67 | 21.51 | 22.35 | 23.18 | 24.02 |
| 33 | | 7.005 | 7.870 | 8.756 | 9.173 | 9.620 | 10.46 | 11.32 | 12.18 | 13.04 | 13.90 | 14.75 | 15.60 | 16.45 | 17.30 | 18.14 | 18.99 | 19.83 | 20.67 | 21.50 | 22.34 | 23.18 | 24.01 |
| 34 | | 6.991 | 7.856 | 8.744 | 9.159 | 9.608 | 10.45 | 11.31 | 12.17 | 13.03 | 13.88 | 14.74 | 15.59 | 16.44 | 17.29 | 18.13 | 18.98 | 19.82 | 20.66 | 21.50 | 22.33 | 23.17 | 24.00 |
| 35 | | 6.978 | 7.842 | 8.731 | 9.145 | 9.596 | 10.44 | 11.30 | 12.16 | 13.02 | 13.87 | 14.73 | 15.58 | 16.43 | 17.28 | 18.12 | 18.97 | 19.81 | 20.65 | 21.49 | 22.32 | 23.16 | 23.99 |
| 36 | | 6.964 | 7.828 | 8.719 | 9.131 | 9.583 | 10.42 | 11.28 | 12.14 | 13.00 | 13.86 | 14.71 | 15.57 | 16.42 | 17.26 | 18.11 | 18.95 | 19.80 | 20.64 | 21.48 | 22.32 | 23.15 | 23.99 |
| 37 | | 6.951 | 7.815 | 8.707 | 9.117 | 9.571 | 10.41 | 11.27 | 12.13 | 12.99 | 13.85 | 14.70 | 15.55 | 16.40 | 17.25 | 18.10 | 18.94 | 19.79 | 20.63 | 21.47 | 22.31 | 23.14 | 23.98 |
| 38 | | 6.937 | 7.801 | 8.695 | 9.102 | 9.559 | 10.39 | 11.26 | 12.12 | 12.97 | 13.83 | 14.69 | 15.54 | 16.39 | 17.24 | 18.09 | 18.93 | 19.78 | 20.62 | 21.46 | 22.30 | 23.14 | 23.97 |
| 39 | | 6.924 | 7.787 | 8.682 | 9.088 | 9.547 | 10.38 | 11.24 | 12.10 | 12.96 | 13.82 | 14.68 | 15.53 | 16.38 | 17.23 | 18.08 | 18.92 | 19.77 | 20.61 | 21.45 | 22.29 | 23.13 | 23.96 |
| 40 | | 6.910 | 7.773 | 8.670 | 9.074 | 9.534 | 10.37 | 11.23 | 12.09 | 12.95 | 13.81 | 14.66 | 15.52 | 16.37 | 17.22 | 18.07 | 18.91 | 19.76 | 20.60 | 21.44 | 22.28 | 23.12 | 23.96 |
| 42 | | 6.884 | 7.746 | 8.645 | 9.046 | 9.509 | 10.34 | 11.20 | 12.06 | 12.92 | 13.78 | 14.64 | 15.49 | 16.34 | 17.19 | 18.04 | 18.89 | 19.74 | 20.58 | 21.42 | 22.26 | 23.10 | 23.94 |
| 44 | | 6.857 | 7.718 | 8.620 | 9.018 | 9.483 | 10.31 | 11.17 | 12.03 | 12.89 | 13.75 | 14.61 | 15.47 | 16.32 | 17.17 | 18.02 | 18.87 | 19.71 | 20.56 | 21.40 | 22.24 | 23.09 | 23.92 |
| 46 | | 6.830 | 7.691 | 8.594 | 8.990 | 9.458 | 10.28 | 11.15 | 12.01 | 12.87 | 13.73 | 14.58 | 15.44 | 16.29 | 17.15 | 18.00 | 18.84 | 19.69 | 20.54 | 21.38 | 22.22 | 23.06 | 23.90 |
| 48 | | 6.804 | 7.663 | 8.569 | 8.961 | 9.432 | 10.25 | 11.12 | 11.98 | 12.84 | 13.70 | 14.55 | 15.41 | 16.28 | 17.12 | 17.97 | 18.82 | 19.67 | 20.51 | 21.36 | 22.20 | 23.04 | 23.88 |
| 50 | | 6.777 | 7.636 | 8.544 | 8.933 | 9.407 | 10.22 | 11.09 | 11.95 | 12.81 | 13.67 | 14.53 | 15.37 | 16.24 | 17.09 | 17.95 | 18.80 | 19.65 | 20.49 | 21.34 | 22.18 | 23.02 | 23.86 |
| 52 | | 6.751 | 7.609 | 8.518 | 8.905 | 9.381 | 10.20 | 11.06 | 11.92 | 12.78 | 13.64 | 14.50 | 15.36 | 16.21 | 17.07 | 17.92 | 18.77 | 19.62 | 20.47 | 21.32 | 22.16 | 23.00 | 23.84 |
| 54 | | 6.725 | 7.582 | 8.493 | 8.877 | 9.355 | 10.17 | 11.01 | 11.89 | 12.75 | 13.62 | 14.47 | 15.33 | 16.19 | 17.03 | 17.90 | 18.75 | 19.60 | 20.45 | 21.29 | 22.14 | 22.98 | 23.82 |
| 56 | | 6.699 | 7.555 | 8.467 | 8.850 | 9.329 | 10.14 | 11.00 | 11.86 | 12.73 | 13.59 | 14.45 | 15.30 | 16.16 | 17.02 | 17.87 | 18.72 | 19.57 | 20.42 | 21.27 | 22.12 | 22.96 | 23.80 |
| 58 | | 6.673 | 7.528 | 8.441 | 8.818 | 9.303 | 10.11 | 10.97 | 11.83 | 12.70 | 13.56 | 14.42 | 15.28 | 16.13 | 16.99 | 17.84 | 18.70 | 19.55 | 20.40 | 21.25 | 22.09 | 22.94 | 23.78 |
| 60 | | 6.648 | 7.501 | 8.416 | 8.793 | 9.276 | 10.08 | 10.94 | 11.81 | 12.67 | 13.53 | 14.39 | 15.25 | 16.11 | 16.96 | 17.82 | 18.67 | 19.52 | 20.37 | 21.22 | 22.07 | 22.92 | 23.76 |
| 63 | | 6.610 | 7.462 | 8.378 | 8.751 | 9.237 | 10.04 | 10.90 | 11.76 | 12.63 | 13.49 | 14.36 | 15.21 | 16.07 | 16.92 | 17.78 | 18.63 | 19.48 | 20.36 | 21.19 | 22.03 | 22.88 | 23.73 |
| 66 | | 6.572 | 7.422 | 8.340 | 8.710 | 9.198 | 9.996 | 10.86 | 11.72 | 12.58 | 13.44 | 14.33 | 15.16 | 16.02 | 16.88 | 17.74 | 18.59 | 19.45 | 20.30 | 21.15 | 22.00 | 22.85 | 23.69 |
| 69 | | 6.535 | 7.383 | 8.302 | 8.669 | 9.160 | 9.954 | 10.81 | 11.68 | 12.54 | 13.40 | 14.26 | 15.12 | 15.98 | 16.84 | 17.70 | 18.58 | 19.41 | 20.26 | 21.11 | 21.96 | 22.81 | 23.66 |
| 72 | | 6.498 | 7.345 | 8.264 | 8.628 | 9.120 | 9.912 | 10.77 | 11.63 | 12.50 | 13.36 | 14.22 | 15.08 | 15.94 | 16.80 | 17.65 | 18.51 | 19.37 | 20.22 | 21.07 | 21.92 | 22.77 | 23.62 |
| 75 | | 6.462 | 7.307 | 8.226 | 8.585 | 9.081 | 9.870 | 10.73 | 11.59 | 12.45 | 13.31 | 14.18 | 15.04 | 15.90 | 16.76 | 17.61 | 18.47 | 19.32 | 20.18 | 21.03 | 21.89 | 22.76 | 23.58 |
| 78 | | 6.426 | 7.269 | 8.189 | 8.546 | 9.043 | 9.828 | 10.69 | 11.55 | 12.41 | 13.31 | 14.16 | 14.99 | 15.85 | 16.71 | 17.57 | 18.43 | 19.28 | 20.16 | 20.99 | 21.85 | 22.70 | 23.55 |
| 81 | | 6.391 | 7.231 | 8.151 | 8.507 | 9.004 | 9.787 | 10.64 | 11.51 | 12.37 | 13.23 | 14.12 | 14.95 | 15.81 | 16.67 | 17.50 | 18.39 | 19.24 | 20.10 | 20.95 | 21.81 | 22.66 | 23.51 |
| 84 | | 6.356 | 7.194 | 8.114 | 8.468 | 8.966 | 9.746 | 10.60 | 11.46 | 12.32 | 13.18 | 14.04 | 14.91 | 15.77 | 16.63 | 17.49 | 18.34 | 19.20 | 20.06 | 20.91 | 21.77 | 22.62 | 23.47 |

TABLE 7.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 1.25;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 13.25;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 12.75;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.93;\ \frac{p}{t_S} = 11.72\right]$

| $b_S/t_S$ \ $b_W/t_W$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | | 2.985 | 3.065 | 3.140 | 3.175 | 3.210 | 3.276 | 3.338 | 3.396 | 3.452 | 3.504 | 3.553 | 3.600 | 3.645 | 3.687 | 3.727 | 3.766 | 3.803 | 3.838 | 3.871 | 3.903 | 3.934 | 3.964 |
| 24 | | 2.951 | 3.031 | 3.106 | 3.141 | 3.176 | 3.242 | 3.304 | 3.363 | 3.418 | 3.470 | 3.520 | 3.567 | 3.612 | 3.655 | 3.695 | 3.734 | 3.771 | 3.806 | 3.840 | 3.879 | 3.904 | 3.934 |
| 25 | | 2.918 | 2.998 | 3.073 | 3.108 | 3.143 | 3.209 | 3.271 | 3.330 | 3.385 | 3.438 | 3.488 | 3.535 | 3.580 | 3.623 | 3.664 | 3.703 | 3.740 | 3.776 | 3.810 | 3.843 | 3.874 | 3.904 |
| 26 | | 2.887 | 2.966 | 3.041 | 3.076 | 3.111 | 3.177 | 3.239 | 3.298 | 3.353 | 3.406 | 3.456 | 3.504 | 3.549 | 3.592 | 3.633 | 3.672 | 3.710 | 3.746 | 3.780 | 3.813 | 3.845 | 3.875 |
| 27 | | 2.856 | 2.935 | 3.010 | 3.045 | 3.079 | 3.145 | 3.208 | 3.266 | 3.322 | 3.375 | 3.425 | 3.473 | 3.518 | 3.562 | 3.603 | 3.643 | 3.680 | 3.717 | 3.751 | 3.784 | 3.816 | 3.847 |
| 28 | | 2.826 | 2.905 | 2.979 | 3.015 | 3.049 | 3.115 | 3.177 | 3.236 | 3.292 | 3.345 | 3.395 | 3.443 | 3.489 | 3.532 | 3.574 | 3.613 | 3.651 | 3.688 | 3.723 | 3.756 | 3.788 | 3.819 |
| 29 | | 2.798 | 2.876 | 2.950 | 2.985 | 3.020 | 3.085 | 3.148 | 3.206 | 3.262 | 3.315 | 3.366 | 3.414 | 3.460 | 3.503 | 3.545 | 3.585 | 3.623 | 3.660 | 3.695 | 3.729 | 3.761 | 3.792 |
| 30 | | 2.770 | 2.848 | 2.922 | 2.957 | 2.991 | 3.057 | 3.119 | 3.178 | 3.234 | 3.287 | 3.337 | 3.385 | 3.431 | 3.475 | 3.517 | 3.557 | 3.595 | 3.632 | 3.668 | 3.701 | 3.734 | 3.765 |
| 31 | | 2.743 | 2.821 | 2.894 | 2.929 | 2.963 | 3.029 | 3.091 | 3.150 | 3.206 | 3.259 | 3.309 | 3.357 | 3.403 | 3.447 | 3.489 | 3.530 | 3.568 | 3.605 | 3.641 | 3.675 | 3.708 | 3.739 |
| 32 | | 2.717 | 2.794 | 2.867 | 2.902 | 2.936 | 3.002 | 3.064 | 3.122 | 3.178 | 3.231 | 3.282 | 3.330 | 3.376 | 3.420 | 3.463 | 3.503 | 3.542 | 3.579 | 3.615 | 3.649 | 3.682 | 3.714 |
| 33 | | 2.692 | 2.769 | 2.841 | 2.876 | 2.910 | 2.975 | 3.037 | 3.096 | 3.152 | 3.205 | 3.255 | 3.304 | 3.350 | 3.394 | 3.436 | 3.477 | 3.516 | 3.553 | 3.589 | 3.623 | 3.656 | 3.688 |
| 34 | | 2.667 | 2.744 | 2.816 | 2.850 | 2.885 | 2.950 | 3.011 | 3.070 | 3.126 | 3.179 | 3.229 | 3.278 | 3.324 | 3.368 | 3.411 | 3.451 | 3.490 | 3.528 | 3.564 | 3.598 | 3.632 | 3.664 |
| 35 | | 2.643 | 2.719 | 2.791 | 2.825 | 2.860 | 2.924 | 2.986 | 3.044 | 3.100 | 3.153 | 3.204 | 3.252 | 3.299 | 3.343 | 3.385 | 3.426 | 3.465 | 3.503 | 3.539 | 3.574 | 3.607 | 3.639 |
| 36 | | 2.620 | 2.696 | 2.767 | 2.802 | 2.835 | 2.900 | 2.961 | 3.020 | 3.075 | 3.128 | 3.179 | 3.227 | 3.274 | 3.318 | 3.361 | 3.402 | 3.441 | 3.478 | 3.515 | 3.550 | 3.583 | 3.615 |
| 37 | | 2.597 | 2.673 | 2.744 | 2.778 | 2.812 | 2.876 | 2.937 | 2.996 | 3.051 | 3.104 | 3.155 | 3.203 | 3.250 | 3.294 | 3.337 | 3.377 | 3.417 | 3.455 | 3.491 | 3.526 | 3.560 | 3.592 |
| 38 | | 2.576 | 2.650 | 2.721 | 2.755 | 2.789 | 2.853 | 2.914 | 2.972 | 3.027 | 3.080 | 3.131 | 3.179 | 3.226 | 3.270 | 3.313 | 3.354 | 3.393 | 3.431 | 3.468 | 3.503 | 3.536 | 3.569 |
| 39 | | 2.554 | 2.628 | 2.699 | 2.733 | 2.766 | 2.830 | 2.891 | 2.949 | 3.004 | 3.057 | 3.108 | 3.156 | 3.203 | 3.247 | 3.290 | 3.331 | 3.370 | 3.408 | 3.445 | 3.480 | 3.514 | 3.547 |
| 40 | $\bar{t}/t_S$ | 2.533 | 2.607 | 2.678 | 2.711 | 2.744 | 2.808 | 2.869 | 2.927 | 2.982 | 3.025 | 3.085 | 3.133 | 3.180 | 3.224 | 3.267 | 3.308 | 3.348 | 3.386 | 3.422 | 3.457 | 3.491 | 3.524 |
| 42 | | 2.493 | 2.566 | 2.636 | 2.669 | 2.702 | 2.765 | 2.826 | 2.883 | 2.938 | 2.991 | 3.041 | 3.089 | 3.136 | 3.180 | 3.223 | 3.264 | 3.304 | 3.342 | 3.378 | 3.414 | 3.448 | 3.481 |
| 44 | | 2.455 | 2.528 | 2.596 | 2.629 | 2.662 | 2.725 | 2.784 | 2.842 | 2.896 | 2.949 | 2.999 | 3.047 | 3.093 | 3.138 | 3.180 | 3.221 | 3.261 | 3.299 | 3.336 | 3.372 | 3.406 | 3.439 |
| 46 | | 2.419 | 2.491 | 2.559 | 2.591 | 2.624 | 2.686 | 2.746 | 2.802 | 2.856 | 2.908 | 2.958 | 3.006 | 3.052 | 3.097 | 3.139 | 3.181 | 3.220 | 3.259 | 3.295 | 3.331 | 3.366 | 3.399 |
| 48 | | 2.386 | 2.455 | 2.523 | 2.555 | 2.587 | 2.649 | 2.707 | 2.764 | 2.818 | 2.870 | 2.919 | 2.967 | 3.013 | 3.057 | 3.100 | 3.141 | 3.181 | 3.219 | 3.256 | 3.292 | 3.326 | 3.360 |
| 50 | | 2.362 | 2.422 | 2.488 | 2.520 | 2.552 | 2.613 | 2.671 | 2.727 | 2.781 | 2.832 | 2.882 | 2.930 | 2.975 | 3.020 | 3.062 | 3.103 | 3.143 | 3.181 | 3.218 | 3.254 | 3.288 | 3.322 |
| 52 | | 2.306 | 2.390 | 2.456 | 2.487 | 2.519 | 2.579 | 2.637 | 2.692 | 2.746 | 2.797 | 2.849 | 2.893 | 2.939 | 2.983 | 3.026 | 3.067 | 3.106 | 3.144 | 3.181 | 3.217 | 3.252 | 3.285 |
| 54 | | 2.291 | 2.359 | 2.424 | 2.455 | 2.487 | 2.546 | 2.604 | 2.659 | 2.712 | 2.762 | 2.811 | 2.859 | 2.904 | 2.946 | 2.990 | 3.031 | 3.071 | 3.109 | 3.146 | 3.182 | 3.216 | 3.250 |
| 56 | | 2.263 | 2.330 | 2.394 | 2.425 | 2.456 | 2.515 | 2.572 | 2.626 | 2.679 | 2.729 | 2.778 | 2.825 | 2.870 | 2.914 | 2.956 | 2.997 | 3.036 | 3.074 | 3.111 | 3.147 | 3.182 | 3.215 |
| 58 | | 2.235 | 2.302 | 2.365 | 2.396 | 2.426 | 2.485 | 2.541 | 2.595 | 2.647 | 2.698 | 2.746 | 2.793 | 2.838 | 2.881 | 2.923 | 2.964 | 3.003 | 3.041 | 3.078 | 3.114 | 3.148 | 3.182 |
| 60 | | 2.209 | 2.275 | 2.338 | 2.368 | 2.398 | 2.456 | 2.512 | 2.565 | 2.617 | 2.667 | 2.715 | 2.761 | 2.806 | 2.849 | 2.891 | 2.932 | 2.971 | 3.009 | 3.046 | 3.081 | 3.116 | 3.149 |
| 63 | | 2.172 | 2.236 | 2.298 | 2.328 | 2.357 | 2.415 | 2.470 | 2.523 | 2.574 | 2.623 | 2.670 | 2.716 | 2.761 | 2.804 | 2.845 | 2.886 | 2.925 | 2.962 | 2.999 | 3.035 | 3.069 | 3.103 |
| 66 | | 2.137 | 2.200 | 2.261 | 2.290 | 2.319 | 2.376 | 2.430 | 2.482 | 2.532 | 2.582 | 2.628 | 2.674 | 2.718 | 2.760 | 2.802 | 2.842 | 2.880 | 2.918 | 2.955 | 2.990 | 3.024 | 3.058 |
| 69 | | 2.104 | 2.166 | 2.226 | 2.255 | 2.283 | 2.339 | 2.392 | 2.444 | 2.493 | 2.542 | 2.588 | 2.633 | 2.677 | 2.719 | 2.760 | 2.800 | 2.838 | 2.876 | 2.912 | 2.947 | 2.982 | 3.015 |
| 72 | | 2.073 | 2.134 | 2.193 | 2.221 | 2.249 | 2.304 | 2.356 | 2.407 | 2.456 | 2.504 | 2.550 | 2.595 | 2.638 | 2.680 | 2.720 | 2.760 | 2.798 | 2.835 | 2.871 | 2.906 | 2.940 | 2.974 |
| 75 | | 2.044 | 2.104 | 2.161 | 2.189 | 2.217 | 2.270 | 2.322 | 2.372 | 2.421 | 2.468 | 2.514 | 2.558 | 2.600 | 2.642 | 2.682 | 2.721 | 2.759 | 2.796 | 2.832 | 2.867 | 2.901 | 2.934 |
| 78 | | 2.016 | 2.075 | 2.131 | 2.159 | 2.186 | 2.239 | 2.290 | 2.339 | 2.387 | 2.434 | 2.479 | 2.522 | 2.565 | 2.606 | 2.646 | 2.685 | 2.722 | 2.759 | 2.794 | 2.829 | 2.863 | 2.896 |
| 81 | | 1.990 | 2.047 | 2.103 | 2.130 | 2.157 | 2.209 | 2.259 | 2.308 | 2.355 | 2.401 | 2.446 | 2.489 | 2.531 | 2.571 | 2.611 | 2.649 | 2.687 | 2.723 | 2.759 | 2.793 | 2.827 | 2.860 |
| 84 | | 1.965 | 2.021 | 2.076 | 2.103 | 2.129 | 2.180 | 2.230 | 2.293 | 2.325 | 2.370 | 2.414 | 2.457 | 2.500 | 2.538 | 2.578 | 2.616 | 2.653 | 2.689 | 2.724 | 2.758 | 2.792 | 2.824 |
| 23 | | 7.905 | 8.990 | 10.10 | 10.66 | 11.23 | 12.38 | 13.54 | 14.72 | 15.91 | 17.11 | 18.31 | 19.53 | 20.75 | 21.98 | 23.21 | 24.45 | 25.69 | 26.94 | 28.20 | 29.45 | 30.70 | 31.96 |
| 24 | | 7.862 | 8.944 | 10.05 | 10.61 | 11.18 | 12.33 | 13.49 | 14.66 | 15.85 | 17.04 | 18.25 | 19.46 | 20.68 | 21.91 | 23.14 | 24.38 | 25.62 | 26.86 | 28.11 | 29.37 | 30.62 | 31.88 |
| 25 | | 7.820 | 8.898 | 10.00 | 10.56 | 11.13 | 12.27 | 13.43 | 14.60 | 15.79 | 16.98 | 18.18 | 19.39 | 20.61 | 21.84 | 23.07 | 24.30 | 25.54 | 26.79 | 28.04 | 29.29 | 30.54 | 31.80 |
| 26 | | 7.778 | 8.853 | 9.954 | 10.51 | 11.08 | 12.22 | 13.37 | 14.54 | 15.72 | 16.92 | 18.12 | 19.33 | 20.54 | 21.77 | 23.00 | 24.23 | 25.47 | 26.71 | 27.96 | 29.21 | 30.46 | 31.72 |
| 27 | | 7.737 | 8.808 | 9.906 | 10.46 | 11.03 | 12.16 | 13.32 | 14.48 | 15.66 | 16.85 | 18.05 | 19.25 | 20.48 | 21.70 | 22.93 | 24.16 | 25.40 | 26.64 | 27.88 | 29.13 | 30.39 | 31.64 |
| 28 | | 7.696 | 8.764 | 9.859 | 10.41 | 10.98 | 12.11 | 13.26 | 14.43 | 15.60 | 16.79 | 17.99 | 19.20 | 20.41 | 21.63 | 22.85 | 24.09 | 25.32 | 26.56 | 27.81 | 29.06 | 30.31 | 31.56 |
| 29 | | 7.656 | 8.721 | 9.812 | 10.37 | 10.93 | 12.06 | 13.21 | 14.37 | 15.54 | 16.73 | 17.93 | 19.13 | 20.34 | 21.56 | 22.78 | 24.01 | 25.25 | 26.49 | 27.73 | 28.98 | 30.23 | 31.48 |
| 30 | | 7.616 | 8.677 | 9.766 | 10.32 | 10.88 | 12.01 | 13.15 | 14.31 | 15.49 | 16.67 | 17.86 | 19.07 | 20.27 | 21.49 | 22.71 | 23.94 | 25.18 | 26.41 | 27.66 | 28.90 | 30.15 | 31.40 |
| 31 | $\bar{h}/t_S$ | 7.576 | 8.634 | 9.720 | 10.27 | 10.83 | 11.95 | 13.10 | 14.26 | 15.43 | 16.61 | 17.80 | 19.00 | 20.21 | 21.42 | 22.64 | 23.87 | 25.10 | 26.34 | 27.58 | 28.83 | 30.07 | 31.33 |
| 32 | | 7.537 | 8.592 | 9.674 | 10.22 | 10.78 | 11.90 | 13.04 | 14.20 | 15.37 | 16.55 | 17.74 | 18.92 | 20.14 | 21.36 | 22.58 | 23.80 | 25.03 | 26.27 | 27.51 | 28.75 | 30.00 | 31.25 |
| 33 | | 7.499 | 8.550 | 9.629 | 10.18 | 10.73 | 11.85 | 12.99 | 14.14 | 15.31 | 16.49 | 17.68 | 18.87 | 20.08 | 21.29 | 22.51 | 23.73 | 24.96 | 26.19 | 27.43 | 28.68 | 29.92 | 31.17 |
| 34 | | 7.460 | 8.506 | 9.585 | 10.13 | 10.68 | 11.80 | 12.94 | 14.09 | 15.25 | 16.43 | 17.61 | 18.81 | 20.01 | 21.22 | 22.44 | 23.66 | 24.89 | 26.12 | 27.36 | 28.60 | 29.85 | 31.09 |
| 35 | | 7.423 | 8.467 | 9.540 | 10.09 | 10.64 | 11.75 | 12.89 | 14.03 | 15.20 | 16.37 | 17.55 | 18.75 | 19.95 | 21.16 | 22.37 | 23.59 | 24.82 | 26.05 | 27.29 | 28.53 | 29.77 | 31.02 |
| 36 | | 7.385 | 8.427 | 9.497 | 10.04 | 10.59 | 11.70 | 12.83 | 13.98 | 15.14 | 16.31 | 17.49 | 18.68 | 19.88 | 21.09 | 22.30 | 23.52 | 24.75 | 25.98 | 27.21 | 28.45 | 29.69 | 30.94 |
| 37 | | 7.348 | 8.387 | 9.453 | 9.996 | 10.54 | 11.65 | 12.78 | 13.93 | 15.08 | 16.25 | 17.43 | 18.60 | 19.82 | 21.03 | 22.24 | 23.46 | 24.68 | 25.91 | 27.14 | 28.38 | 29.62 | 30.87 |
| 38 | | 7.312 | 8.347 | 9.410 | 9.952 | 10.50 | 11.61 | 12.73 | 13.87 | 15.03 | 16.20 | 17.37 | 18.56 | 19.76 | 20.96 | 22.17 | 23.39 | 24.61 | 25.84 | 27.07 | 28.31 | 29.55 | 30.79 |
| 39 | | 7.275 | 8.307 | 9.368 | 9.908 | 10.45 | 11.56 | 12.68 | 13.82 | 14.97 | 16.14 | 17.31 | 18.50 | 19.69 | 20.90 | 22.10 | 23.32 | 24.54 | 25.77 | 27.00 | 28.23 | 29.47 | 30.71 |
| 40 | | 7.240 | 8.268 | 9.326 | 9.864 | 10.41 | 11.51 | 12.63 | 13.77 | 14.92 | 16.08 | 17.26 | 18.44 | 19.63 | 20.83 | 22.04 | 23.25 | 24.47 | 25.70 | 26.93 | 28.16 | 29.40 | 30.64 |

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TABLE 7.- HAT-PANEL PROPERTIES $\left[\frac{t_W}{t_S} = 1.25;\ \frac{b_H}{b_W} = 0.8;\ \frac{b_A}{t_W} = 13.25;\ \frac{b_H}{t_W} = 0.8\frac{b_W}{t_W};\ \frac{b_R}{t_W} = 0.8\frac{b_W}{t_W} + 12.75;\ \frac{r}{t_W} = 3.13;\ \frac{d}{t_S} = 2.93;\ \frac{p}{t_S} = 11.72\right]$ - Concluded

| $\frac{b_S}{t_S}$ \ $\frac{b_W}{t_W}$ | | 19 | 21 | 23 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | $\frac{\bar{h}}{t_S}$ | 7.169 | 8.191 | 9.243 | 9.778 | 10.32 | 11.42 | 12.53 | 13.66 | 14.81 | 15.97 | 17.14 | 18.32 | 19.51 | 20.70 | 21.91 | 23.12 | 24.34 | 25.56 | 26.78 | 28.02 | 29.25 | 30.49 |
| 44 | | 7.100 | 8.116 | 9.161 | 9.694 | 10.23 | 11.32 | 12.44 | 13.56 | 14.70 | 15.86 | 17.02 | 18.17 | 19.39 | 20.58 | 21.78 | 22.99 | 24.20 | 25.42 | 26.65 | 27.87 | 29.11 | 30.34 |
| 46 | | 7.032 | 8.042 | 9.082 | 9.611 | 10.15 | 11.23 | 12.34 | 13.46 | 14.60 | 15.75 | 16.91 | 18.08 | 19.27 | 20.46 | 21.65 | 22.86 | 24.07 | 25.28 | 26.51 | 27.73 | 28.96 | 30.20 |
| 48 | | 6.966 | 7.969 | 9.003 | 9.530 | 10.06 | 11.14 | 12.24 | 13.36 | 14.50 | 15.64 | 16.80 | 17.97 | 19.15 | 20.33 | 21.53 | 22.73 | 23.94 | 25.15 | 26.37 | 27.59 | 28.82 | 30.06 |
| 50 | | 6.901 | 7.898 | 8.926 | 9.450 | 9.979 | 11.06 | 12.15 | 13.26 | 14.39 | 15.54 | 16.69 | 17.85 | 19.03 | 20.21 | 21.40 | 22.60 | 23.81 | 25.02 | 26.23 | 27.46 | 28.68 | 29.91 |
| 52 | | 6.838 | 7.828 | 8.850 | 9.371 | 9.898 | 10.97 | 12.06 | 13.17 | 14.29 | 15.43 | 16.59 | 17.74 | 18.91 | 20.09 | 21.28 | 22.48 | 23.68 | 24.89 | 26.10 | 27.32 | 28.54 | 29.77 |
| 54 | | 6.775 | 7.760 | 8.776 | 9.294 | 9.818 | 10.88 | 11.97 | 13.07 | 14.19 | 15.33 | 16.47 | 17.63 | 18.80 | 19.98 | 21.16 | 22.35 | 23.55 | 24.76 | 25.97 | 27.18 | 28.41 | 29.63 |
| 56 | | 6.714 | 7.693 | 8.703 | 9.218 | 9.740 | 10.80 | 11.88 | 12.98 | 14.10 | 15.23 | 16.37 | 17.52 | 18.69 | 19.86 | 21.04 | 22.23 | 23.43 | 24.63 | 25.84 | 27.06 | 28.27 | 29.49 |
| 58 | | 6.654 | 7.627 | 8.631 | 9.144 | 9.662 | 10.72 | 11.79 | 12.89 | 14.00 | 15.12 | 16.26 | 17.41 | 18.57 | 19.74 | 20.92 | 22.11 | 23.30 | 24.50 | 25.71 | 26.92 | 28.13 | 29.35 |
| 60 | | 6.595 | 7.562 | 8.561 | 9.071 | 9.587 | 10.64 | 11.71 | 12.80 | 13.91 | 15.03 | 16.16 | 17.31 | 18.46 | 19.63 | 20.80 | 21.99 | 23.18 | 24.37 | 25.58 | 26.79 | 28.00 | 29.22 |
| 63 | | 6.509 | 7.467 | 8.457 | 8.963 | 9.475 | 10.52 | 11.58 | 12.67 | 13.77 | 14.88 | 16.01 | 17.15 | 18.30 | 19.46 | 20.63 | 21.81 | 23.00 | 24.19 | 25.39 | 26.59 | 27.80 | 29.02 |
| 66 | | 6.425 | 7.374 | 8.356 | 8.858 | 9.366 | 10.40 | 11.46 | 12.53 | 13.63 | 14.74 | 15.86 | 16.99 | 18.14 | 19.30 | 20.46 | 21.63 | 22.82 | 24.00 | 25.20 | 26.40 | 27.61 | 28.82 |
| 69 | | 6.344 | 7.284 | 8.258 | 8.756 | 9.260 | 10.29 | 11.34 | 12.41 | 13.49 | 14.60 | 15.71 | 16.84 | 17.98 | 19.13 | 20.29 | 21.46 | 22.64 | 23.82 | 25.01 | 26.21 | 27.41 | 28.62 |
| 72 | | 6.265 | 7.196 | 8.162 | 8.656 | 9.156 | 10.18 | 11.22 | 12.28 | 13.36 | 14.46 | 15.57 | 16.69 | 17.83 | 18.97 | 20.13 | 21.29 | 22.47 | 23.65 | 24.83 | 26.03 | 27.22 | 28.43 |
| 75 | | 6.186 | 7.111 | 8.069 | 8.559 | 9.055 | 10.07 | 11.10 | 12.16 | 13.23 | 14.32 | 15.43 | 16.55 | 17.68 | 18.82 | 19.97 | 21.13 | 22.30 | 23.47 | 24.65 | 25.84 | 27.04 | 28.24 |
| 78 | | 6.112 | 7.028 | 7.977 | 8.463 | 8.956 | 9.962 | 10.99 | 12.04 | 13.11 | 14.19 | 15.29 | 16.40 | 17.53 | 18.66 | 19.81 | 20.96 | 22.13 | 23.30 | 24.48 | 25.66 | 26.85 | 28.05 |
| 81 | | 6.039 | 6.946 | 7.888 | 8.371 | 8.859 | 9.858 | 10.88 | 11.92 | 12.98 | 14.06 | 15.15 | 16.26 | 17.38 | 18.51 | 19.65 | 20.80 | 21.96 | 23.13 | 24.30 | 25.48 | 26.67 | 27.86 |
| 84 | | 5.968 | 6.867 | 7.801 | 8.280 | 8.765 | 9.756 | 10.77 | 11.87 | 13.86 | 13.93 | 15.02 | 16.03 | 17.24 | 18.36 | 19.50 | 20.64 | 21.80 | 22.96 | 24.13 | 25.31 | 26.49 | 27.68 |
| 23 | $\frac{\rho}{t_S}$ | 9.271 | 10.35 | 11.43 | 11.97 | 12.50 | 13.56 | 14.62 | 15.68 | 16.73 | 17.78 | 18.82 | 19.86 | 20.89 | 21.92 | 22.95 | 23.98 | 25.00 | 26.02 | 27.04 | 28.06 | 29.08 | 30.09 |
| 24 | | 9.261 | 10.34 | 11.42 | 11.96 | 12.49 | 13.56 | 14.62 | 15.67 | 16.72 | 17.77 | 18.81 | 19.85 | 20.89 | 21.92 | 22.95 | 23.98 | 25.00 | 26.03 | 27.05 | 28.06 | 29.08 | 30.09 |
| 25 | | 9.251 | 10.33 | 11.41 | 11.95 | 12.48 | 13.55 | 14.61 | 15.67 | 16.72 | 17.77 | 18.81 | 19.85 | 20.89 | 21.92 | 22.95 | 23.98 | 25.00 | 26.03 | 27.05 | 28.07 | 29.08 | 30.10 |
| 26 | | 9.242 | 10.32 | 11.40 | 11.94 | 12.47 | 13.54 | 14.60 | 15.66 | 16.71 | 17.76 | 18.81 | 19.85 | 20.88 | 21.92 | 22.95 | 23.98 | 25.00 | 26.03 | 27.05 | 28.07 | 29.09 | 30.10 |
| 27 | | 9.232 | 10.32 | 11.39 | 11.93 | 12.47 | 13.53 | 14.60 | 15.65 | 16.71 | 17.76 | 18.80 | 19.84 | 20.88 | 21.92 | 22.95 | 23.98 | 25.00 | 26.03 | 27.05 | 28.07 | 29.09 | 30.10 |
| 28 | | 9.221 | 10.31 | 11.38 | 11.92 | 12.46 | 13.53 | 14.59 | 15.65 | 16.70 | 17.75 | 18.80 | 19.84 | 20.88 | 21.91 | 22.95 | 23.98 | 25.00 | 26.03 | 27.05 | 28.07 | 29.09 | 30.11 |
| 29 | | 9.211 | 10.30 | 11.38 | 11.91 | 12.45 | 13.52 | 14.58 | 15.64 | 16.70 | 17.75 | 18.79 | 19.83 | 20.88 | 21.91 | 22.94 | 23.97 | 25.00 | 26.03 | 27.05 | 28.07 | 29.09 | 30.11 |
| 30 | | 9.201 | 10.29 | 11.37 | 11.90 | 12.44 | 13.51 | 14.57 | 15.63 | 16.69 | 17.74 | 18.79 | 19.83 | 20.87 | 21.91 | 22.94 | 23.97 | 25.00 | 26.03 | 27.05 | 28.07 | 29.09 | 30.11 |
| 31 | | 9.191 | 10.28 | 11.36 | 11.89 | 12.43 | 13.50 | 14.57 | 15.63 | 16.68 | 17.73 | 18.78 | 19.83 | 20.87 | 21.91 | 22.94 | 23.97 | 25.00 | 26.03 | 27.06 | 28.07 | 29.09 | 30.11 |
| 32 | | 9.180 | 10.27 | 11.35 | 11.88 | 12.42 | 13.49 | 14.56 | 15.62 | 16.68 | 17.73 | 18.78 | 19.82 | 20.86 | 21.90 | 22.94 | 23.97 | 25.00 | 26.03 | 27.05 | 28.07 | 29.10 | 30.11 |
| 33 | | 9.170 | 10.26 | 11.34 | 11.87 | 12.41 | 13.48 | 14.55 | 15.61 | 16.67 | 17.72 | 18.77 | 19.82 | 20.86 | 21.90 | 22.93 | 23.97 | 25.00 | 26.03 | 27.06 | 28.07 | 29.10 | 30.12 |
| 34 | | 9.159 | 10.25 | 11.33 | 11.87 | 12.41 | 13.48 | 14.54 | 15.60 | 16.66 | 17.72 | 18.77 | 19.81 | 20.86 | 21.90 | 22.93 | 23.97 | 25.00 | 26.02 | 27.06 | 28.08 | 29.10 | 30.12 |
| 35 | | 9.149 | 10.24 | 11.32 | 11.86 | 12.39 | 13.47 | 14.53 | 15.60 | 16.66 | 17.71 | 18.76 | 19.81 | 20.85 | 21.89 | 22.93 | 23.96 | 24.99 | 26.02 | 27.05 | 28.07 | 29.10 | 30.12 |
| 36 | | 9.138 | 10.23 | 11.31 | 11.85 | 12.39 | 13.46 | 14.53 | 15.59 | 16.65 | 17.70 | 18.75 | 19.80 | 20.85 | 21.89 | 22.93 | 23.96 | 24.99 | 26.02 | 27.06 | 28.07 | 29.10 | 30.12 |
| 37 | | 9.127 | 10.21 | 11.30 | 11.84 | 12.38 | 13.45 | 14.52 | 15.58 | 16.64 | 17.70 | 18.75 | 19.80 | 20.83 | 21.88 | 22.92 | 23.96 | 24.99 | 26.02 | 27.05 | 28.07 | 29.10 | 30.12 |
| 38 | | 9.117 | 10.20 | 11.29 | 11.83 | 12.37 | 13.44 | 14.51 | 15.57 | 16.63 | 17.69 | 18.74 | 19.79 | 20.84 | 21.88 | 22.92 | 23.95 | 24.99 | 26.02 | 27.05 | 28.07 | 29.10 | 30.12 |
| 39 | | 9.106 | 10.19 | 11.28 | 11.82 | 12.36 | 13.43 | 14.50 | 15.56 | 16.63 | 17.68 | 18.74 | 19.79 | 20.83 | 21.88 | 22.91 | 23.95 | 24.99 | 26.02 | 27.05 | 28.07 | 29.10 | 30.12 |
| 40 | | 9.095 | 10.18 | 11.27 | 11.81 | 12.35 | 13.42 | 14.49 | 15.56 | 16.62 | 17.68 | 18.73 | 19.78 | 20.83 | 21.87 | 22.91 | 23.95 | 24.98 | 26.01 | 27.04 | 28.07 | 29.10 | 30.12 |
| 42 | | 9.074 | 10.16 | 11.25 | 11.79 | 12.33 | 13.40 | 14.47 | 15.54 | 16.60 | 17.66 | 18.72 | 19.77 | 20.82 | 21.86 | 22.90 | 23.94 | 24.98 | 26.01 | 27.04 | 28.07 | 29.10 | 30.12 |
| 44 | | 9.052 | 10.14 | 11.22 | 11.77 | 12.31 | 13.38 | 14.45 | 15.52 | 16.59 | 17.65 | 18.70 | 19.75 | 20.81 | 21.85 | 22.89 | 23.93 | 24.97 | 26.00 | 27.04 | 28.07 | 29.09 | 30.12 |
| 46 | | 9.030 | 10.12 | 11.20 | 11.74 | 12.28 | 13.36 | 14.43 | 15.50 | 16.57 | 17.63 | 18.69 | 19.74 | 20.80 | 21.84 | 22.88 | 23.92 | 24.96 | 26.00 | 27.03 | 28.06 | 29.09 | 30.12 |
| 48 | | 9.008 | 10.10 | 11.18 | 11.72 | 12.26 | 13.35 | 14.42 | 15.49 | 16.55 | 17.61 | 18.67 | 19.73 | 20.78 | 21.83 | 22.87 | 23.92 | 24.95 | 25.99 | 27.03 | 28.06 | 29.09 | 30.12 |
| 50 | | 8.986 | 10.07 | 11.16 | 11.70 | 12.24 | 13.33 | 14.40 | 15.47 | 16.54 | 17.60 | 18.66 | 19.71 | 20.77 | 21.82 | 22.86 | 23.91 | 24.95 | 25.98 | 27.02 | 28.05 | 29.08 | 30.11 |
| 52 | | 8.963 | 10.05 | 11.14 | 11.68 | 12.22 | 13.31 | 14.38 | 15.45 | 16.52 | 17.58 | 18.64 | 19.70 | 20.75 | 21.81 | 22.85 | 23.90 | 24.94 | 25.98 | 27.01 | 28.05 | 29.08 | 30.11 |
| 54 | | 8.941 | 10.03 | 11.12 | 11.66 | 12.20 | 13.28 | 14.36 | 15.43 | 16.50 | 17.56 | 18.63 | 19.68 | 20.74 | 21.80 | 22.84 | 23.89 | 24.93 | 25.97 | 27.01 | 28.04 | 29.07 | 30.11 |
| 56 | | 8.919 | 10.01 | 11.09 | 11.64 | 12.18 | 13.26 | 14.34 | 15.41 | 16.48 | 17.55 | 18.61 | 19.67 | 20.73 | 21.78 | 22.83 | 23.87 | 24.92 | 25.96 | 27.00 | 28.03 | 29.07 | 30.10 |
| 58 | | 8.896 | 9.985 | 11.07 | 11.61 | 12.16 | 13.24 | 14.32 | 15.39 | 16.46 | 17.53 | 18.59 | 19.65 | 20.71 | 21.76 | 22.82 | 23.86 | 24.90 | 25.95 | 26.99 | 28.03 | 29.06 | 30.10 |
| 60 | | 8.874 | 9.963 | 11.05 | 11.59 | 12.14 | 13.22 | 14.30 | 15.37 | 16.44 | 17.51 | 18.57 | 19.64 | 20.70 | 21.75 | 22.80 | 23.85 | 24.90 | 25.94 | 26.98 | 28.02 | 29.05 | 30.09 |
| 63 | | 8.841 | 9.929 | 11.02 | 11.56 | 12.10 | 13.18 | 14.26 | 15.34 | 16.41 | 17.48 | 18.55 | 19.62 | 20.67 | 21.73 | 22.78 | 23.83 | 24.88 | 25.92 | 26.96 | 28.01 | 29.04 | 30.08 |
| 66 | | 8.807 | 9.895 | 10.98 | 11.52 | 12.07 | 13.15 | 14.23 | 15.31 | 16.38 | 17.45 | 18.52 | 19.58 | 20.65 | 21.70 | 22.76 | 23.81 | 24.86 | 25.91 | 26.95 | 27.99 | 29.03 | 30.07 |
| 69 | | 8.773 | 9.861 | 10.95 | 11.49 | 12.03 | 13.12 | 14.20 | 15.28 | 16.35 | 17.42 | 18.49 | 19.56 | 20.62 | 21.68 | 22.74 | 23.79 | 24.84 | 25.89 | 26.93 | 28.00 | 29.02 | 30.05 |
| 72 | | 8.740 | 9.827 | 10.91 | 11.45 | 12.00 | 13.09 | 14.17 | 15.25 | 16.32 | 17.39 | 18.46 | 19.53 | 20.60 | 21.66 | 22.71 | 23.77 | 24.82 | 25.87 | 26.91 | 27.96 | 29.00 | 30.04 |
| 75 | | 8.707 | 9.793 | 10.88 | 11.42 | 11.97 | 13.06 | 14.13 | 15.21 | 16.29 | 17.36 | 18.43 | 19.50 | 20.57 | 21.63 | 22.69 | 23.75 | 24.80 | 25.85 | 26.90 | 27.94 | 28.99 | 30.03 |
| 78 | | 8.673 | 9.759 | 10.85 | 11.39 | 11.93 | 13.02 | 14.10 | 15.18 | 16.26 | 17.33 | 18.40 | 19.47 | 20.54 | 21.61 | 22.66 | 23.72 | 24.77 | 25.83 | 26.88 | 27.92 | 28.97 | 30.01 |
| 81 | | 8.640 | 9.725 | 10.81 | 11.35 | 11.90 | 12.98 | 14.07 | 15.15 | 16.23 | 17.30 | 18.37 | 19.44 | 20.51 | 21.58 | 22.64 | 23.70 | 24.75 | 25.80 | 26.86 | 27.90 | 28.95 | 30.00 |
| 84 | | 8.607 | 9.610 | 10.78 | 11.32 | 11.86 | 12.95 | 14.03 | 15.13 | 16.19 | 17.27 | 18.34 | 19.41 | 20.48 | 21.55 | 22.61 | 23.67 | 24.73 | 25.78 | 26.83 | 27.88 | 28.93 | 29.98 |

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TABLE 8.- VALUES OF AVERAGE STRESS AT MAXIMUM LOAD FOR COMPARATIVE HAT- AND Z-STIFFENED SPECIMENS[1]

| $\frac{L}{\rho}$ | Average stress, $\bar{\sigma}_f$, ksi | | | |
|---|---|---|---|---|
| | $\frac{b_S}{t_S} = 25$ | | $\frac{b_S}{t_S} = 35$ | |
| | Hat-stiffened panel | Z-stiffened panel | Hat-stiffened panel | Z-stiffened panel |
| (a) As panels subjected to simple compression | | | | |
| 20 | 39.1 | 39.5 | 30.1 | 28.6 |
| 40 | 39.3 | 38.5 | 29.7 | 27.8 |
| 70 | 37.8 | 33.4 | 29.6 | 26.7 |
| (b) As the compression covers of box beams subjected to bending plus compression | | | | |
| 70 | 38.6 | 36.3 | 28.0 | 28.8 |
| (c) As the compression covers of box beams subjected to bending plus vertical shear plus compression | | | | |
| 70 | 40.3 | 42.2 | 28.6 | 30.4 |

[1]All comparative specimens were constructed from the same sheets of bare 24S-T3 aluminum alloy. The compressive yield stress for these sheets was found to vary from 44.0 ksi to 46.0 ksi.

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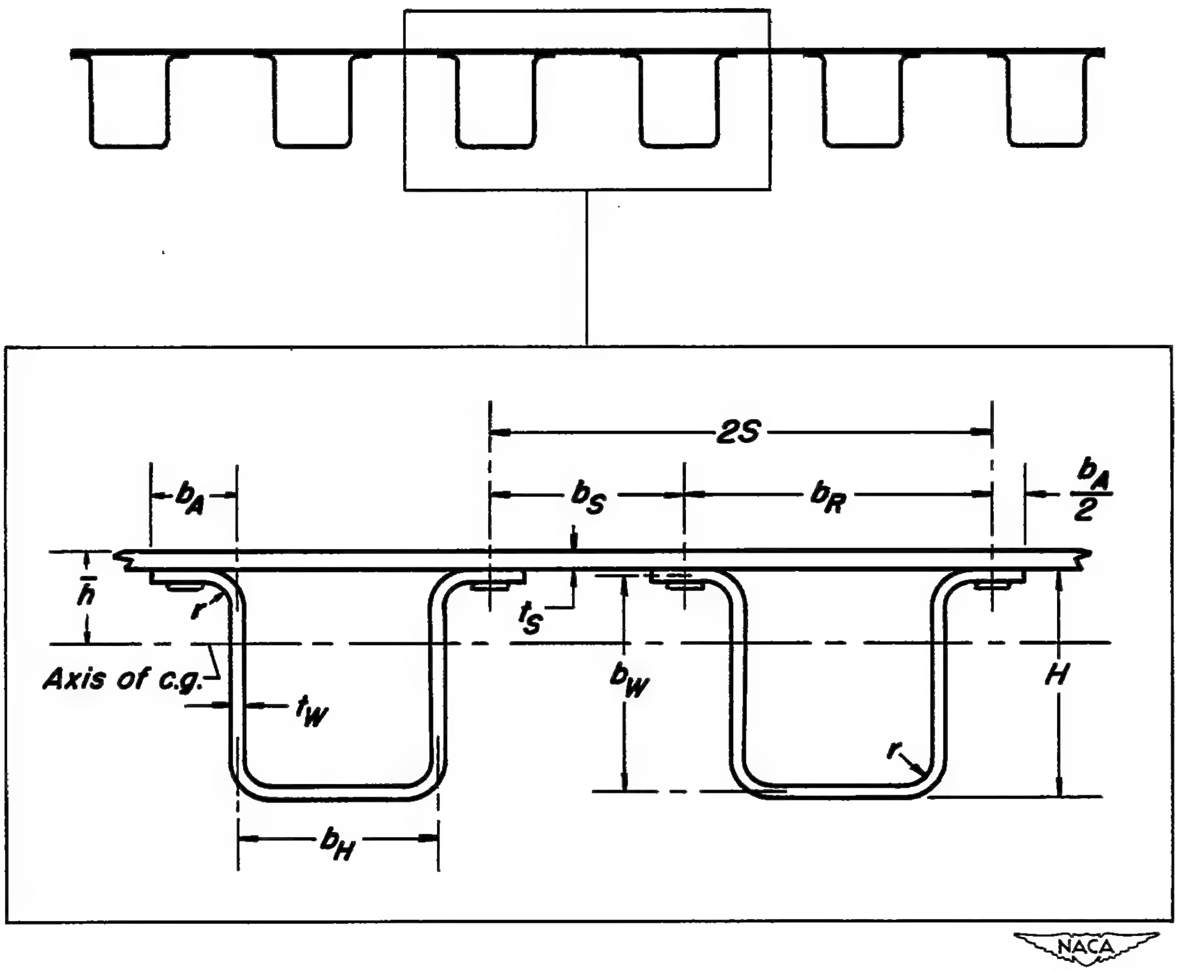



*Figure 1.—Symbols for panel dimensions.*

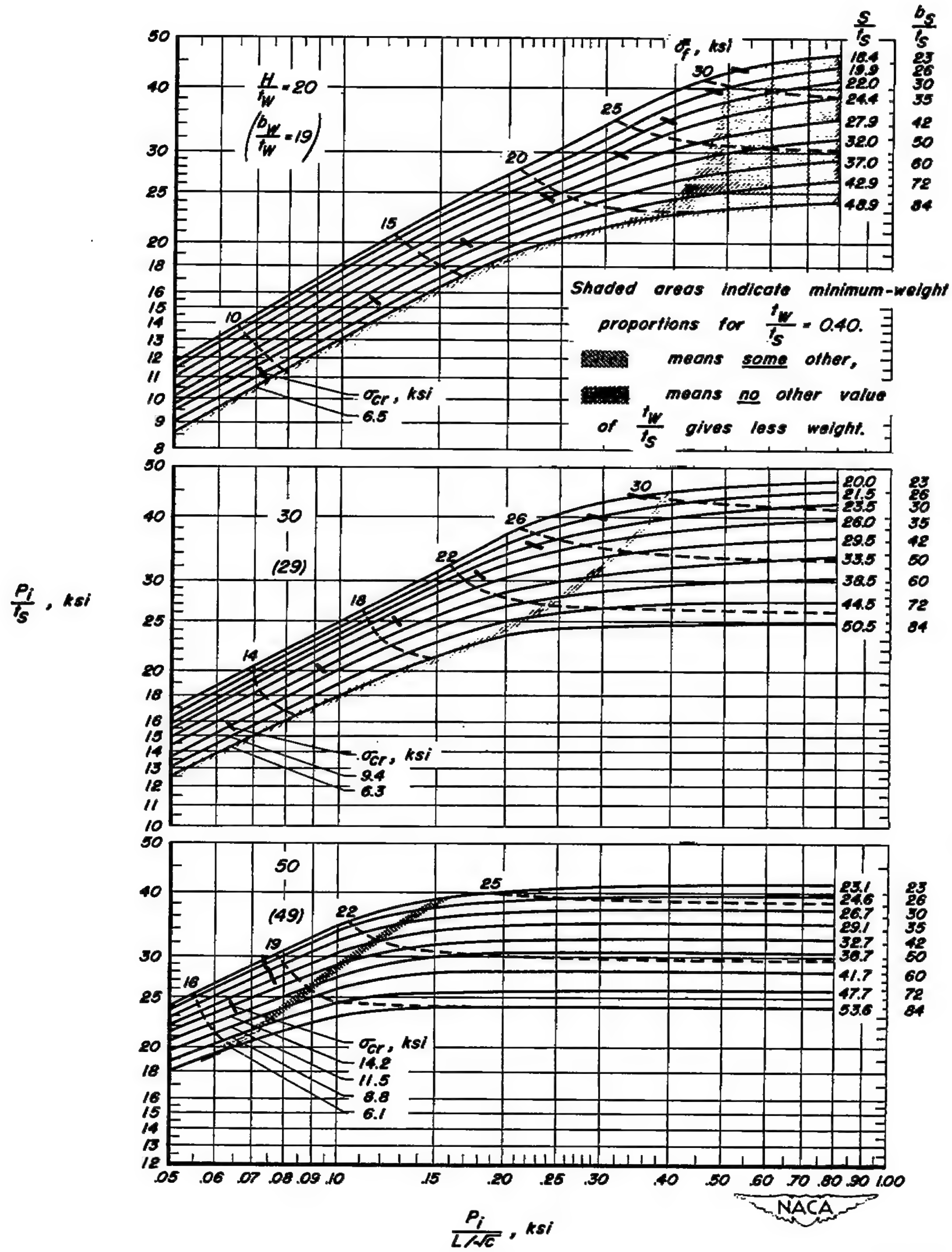



Figure 2.—Direct-reading design chart for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.40$.

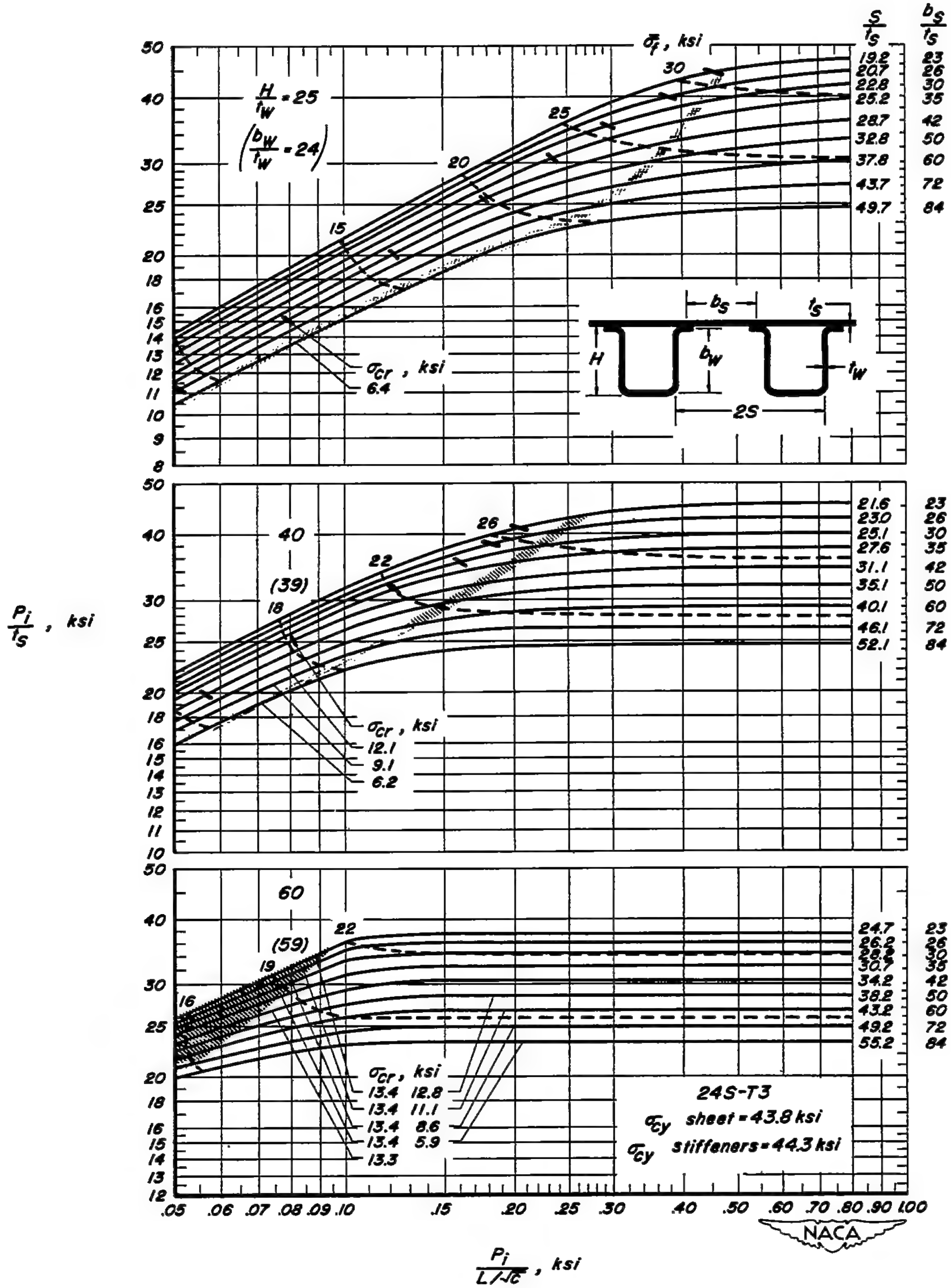



Figure 2.- Concluded

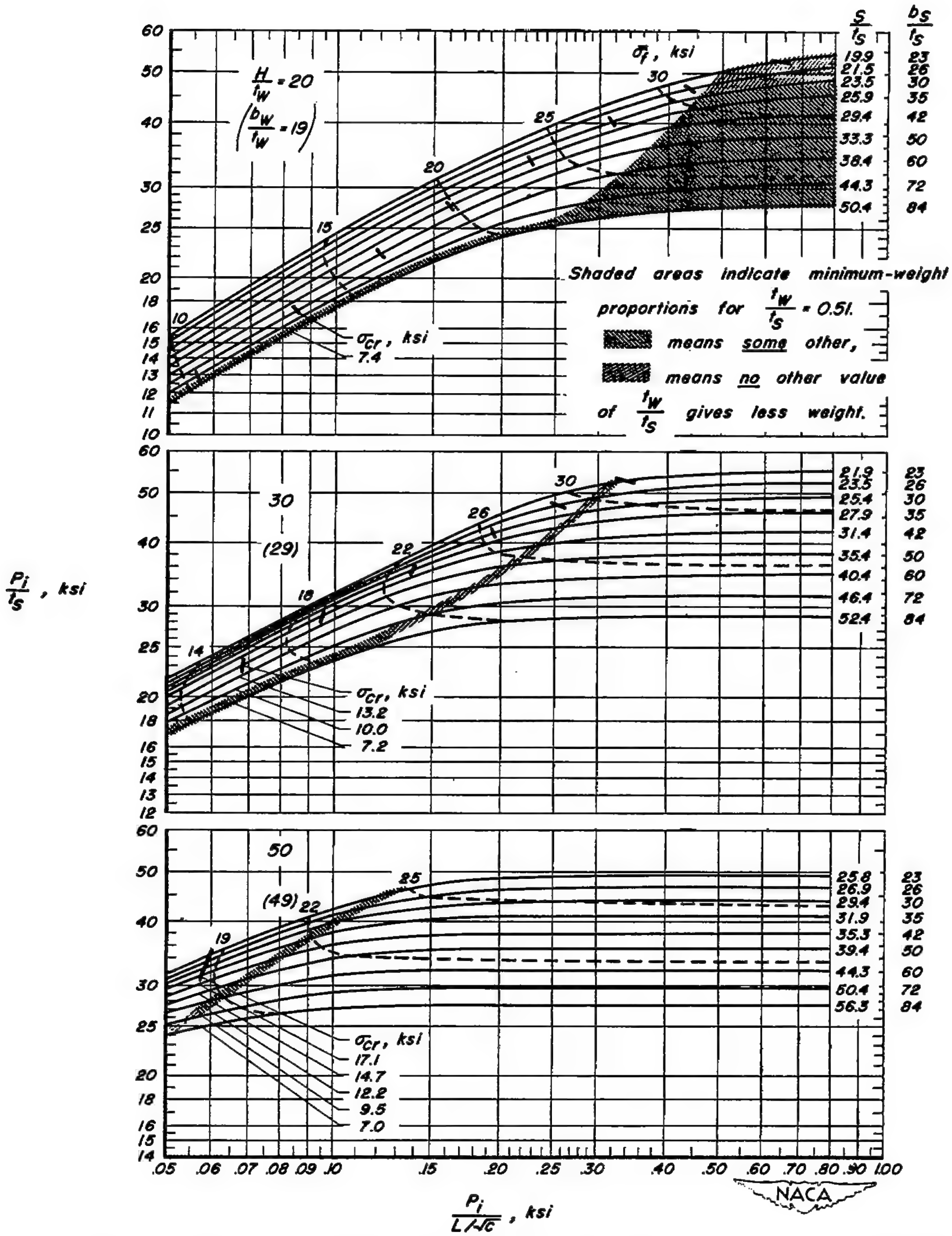



*Figure 3.—Direct-reading design chart for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.51$.*

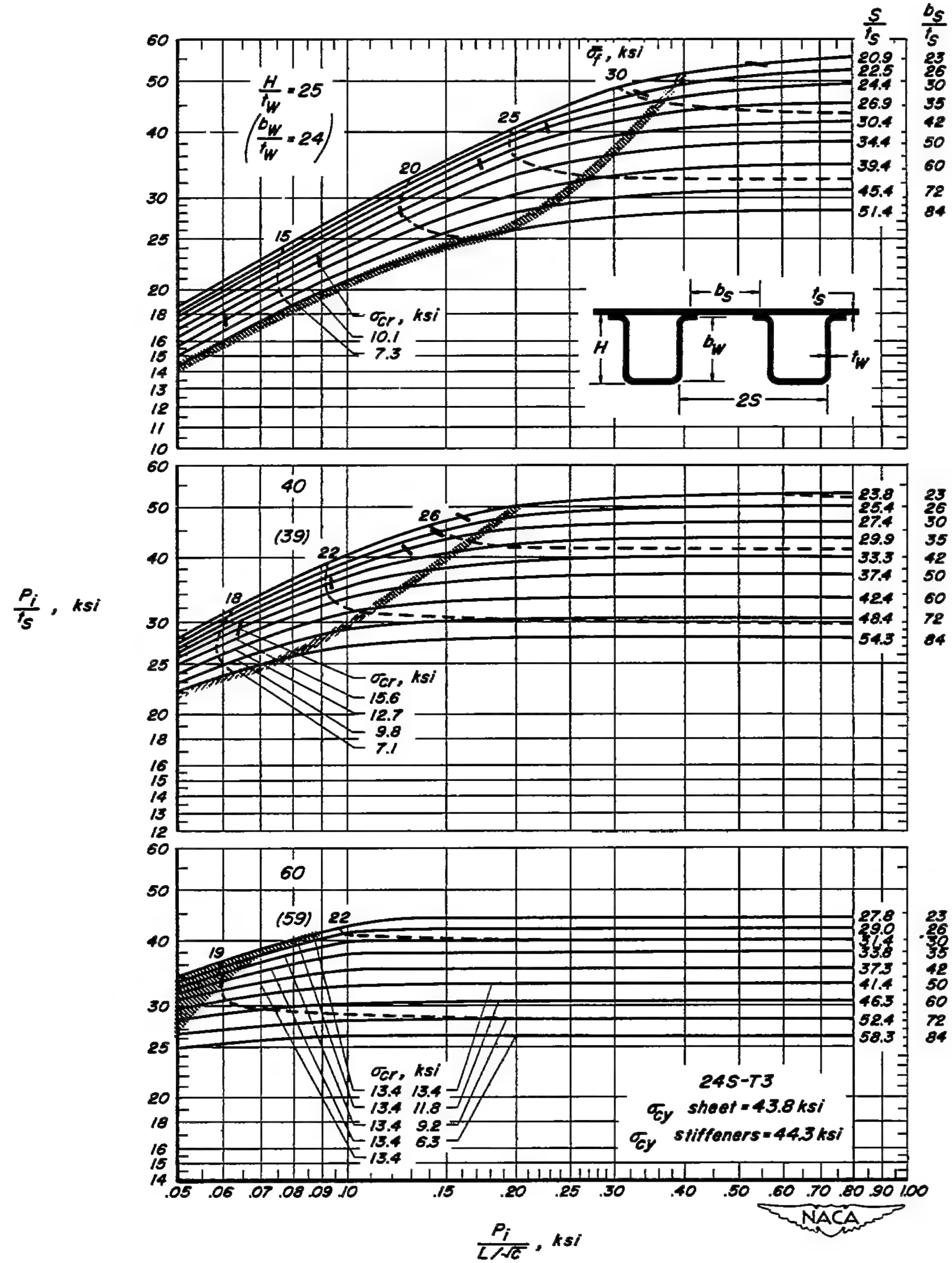



Figure 3.—Concluded

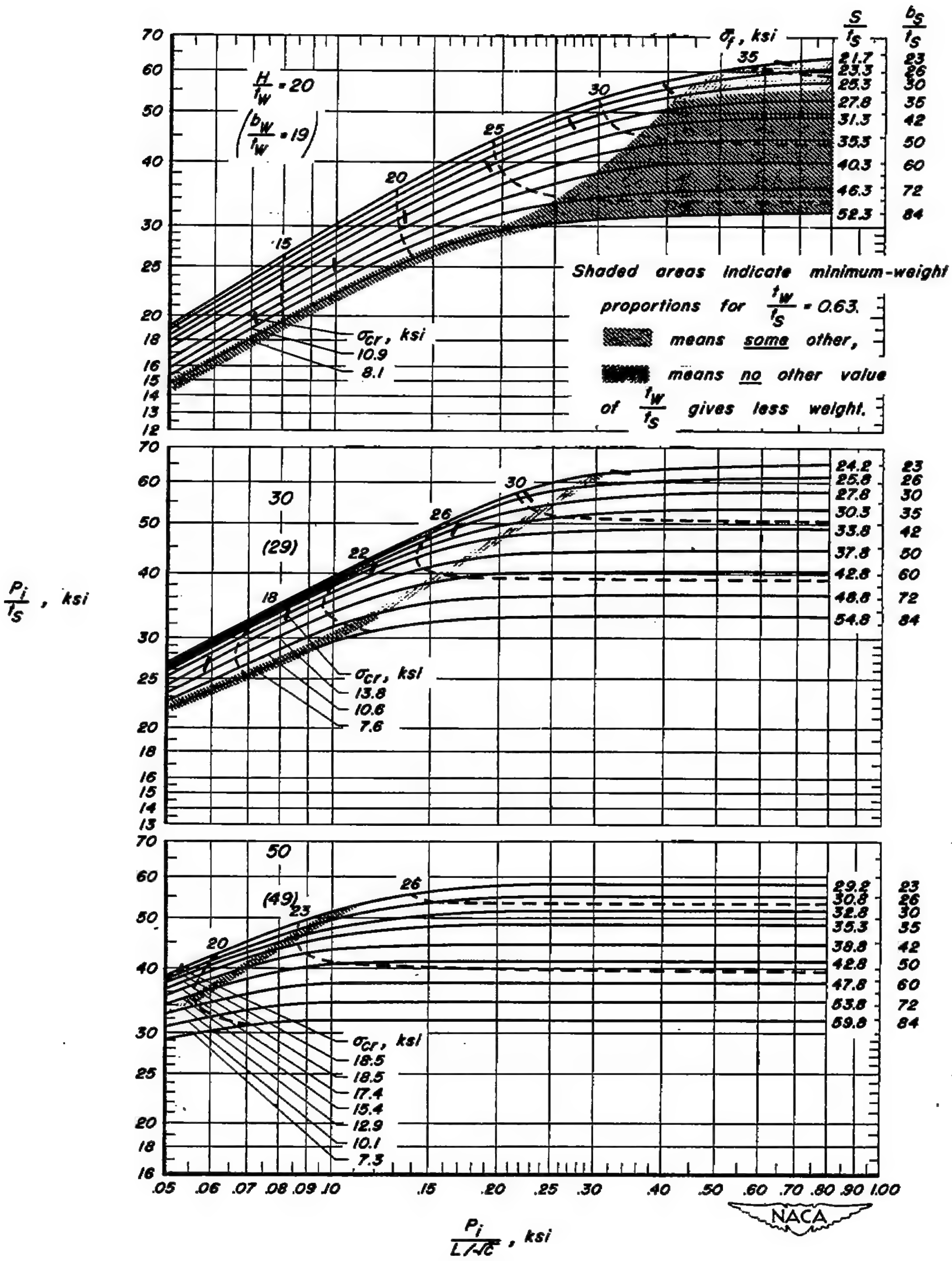



*Figure 4.—Direct-reading design chart for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.63$.*

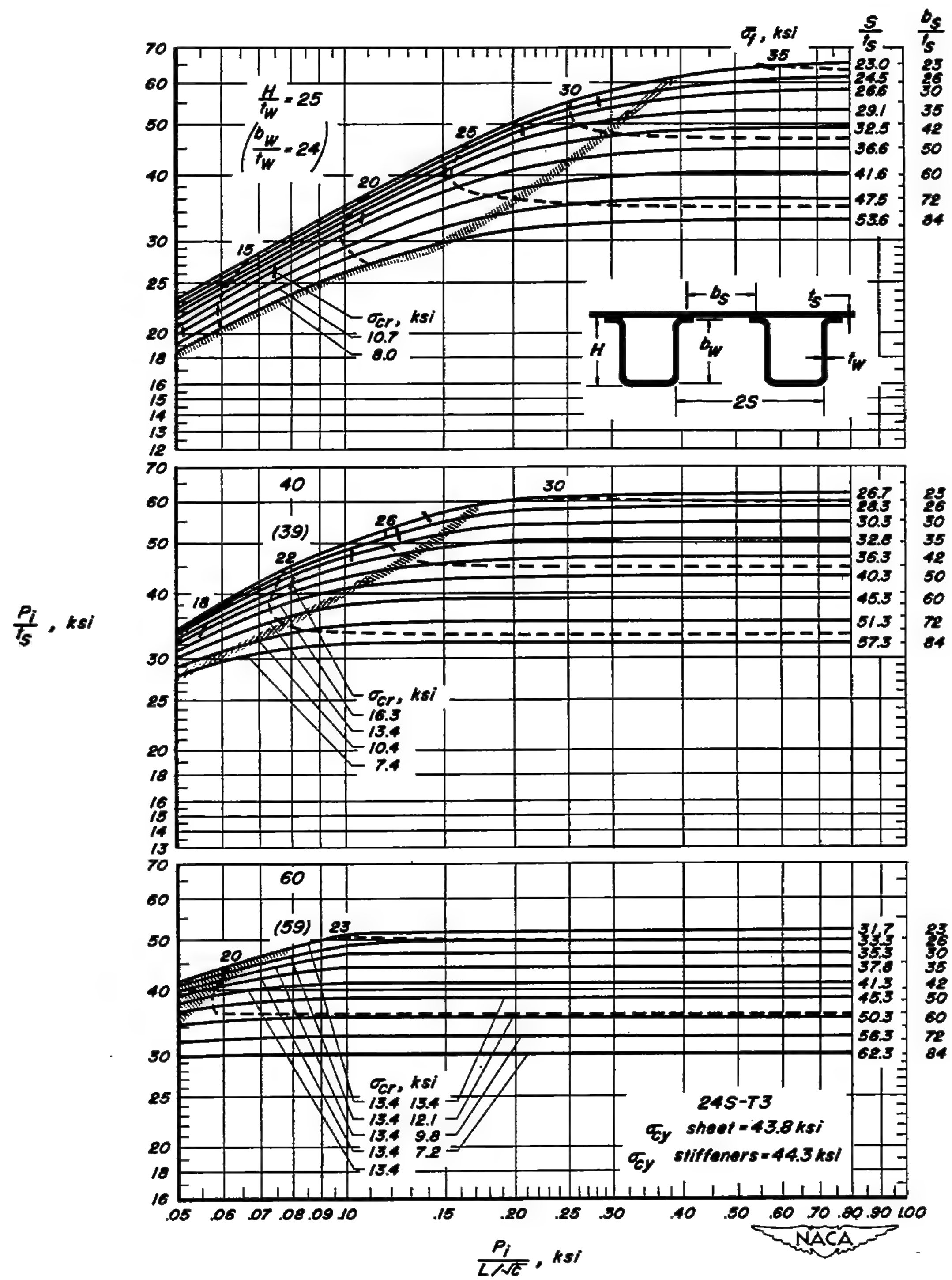



Figure 4.— Concluded

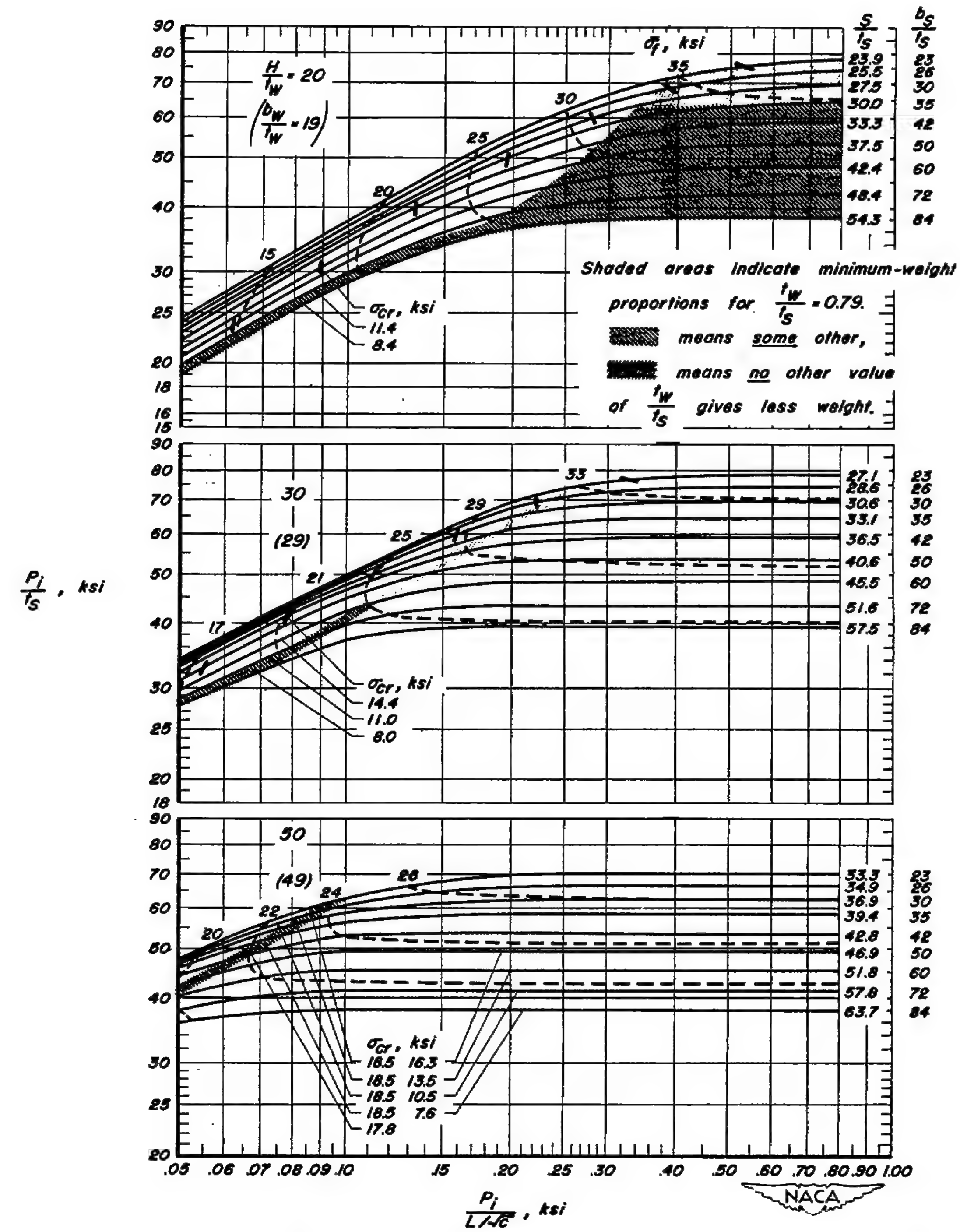



*Figure 5.—Direct-reading design chart for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.79$.*

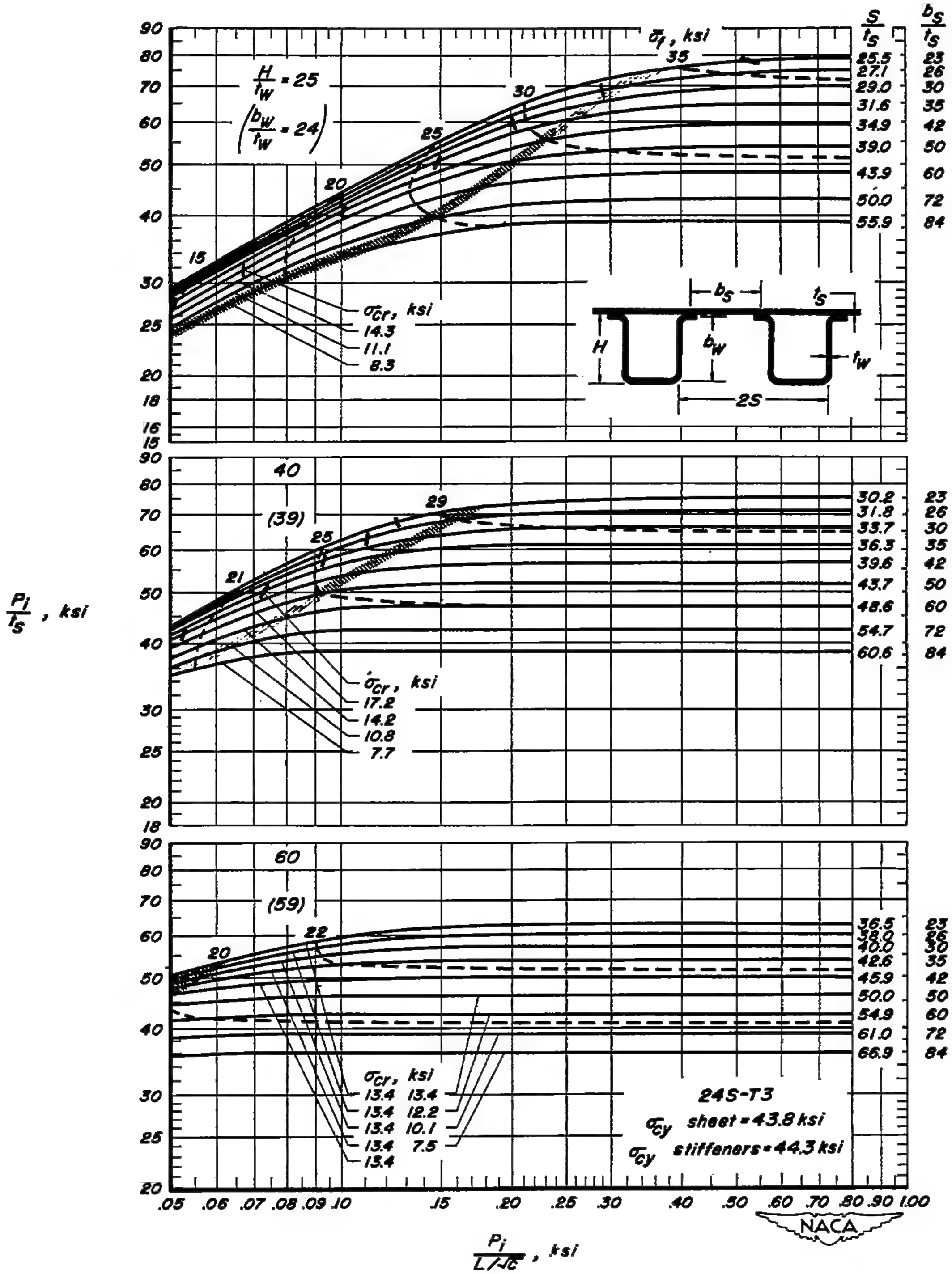



Figure 5.– Concluded

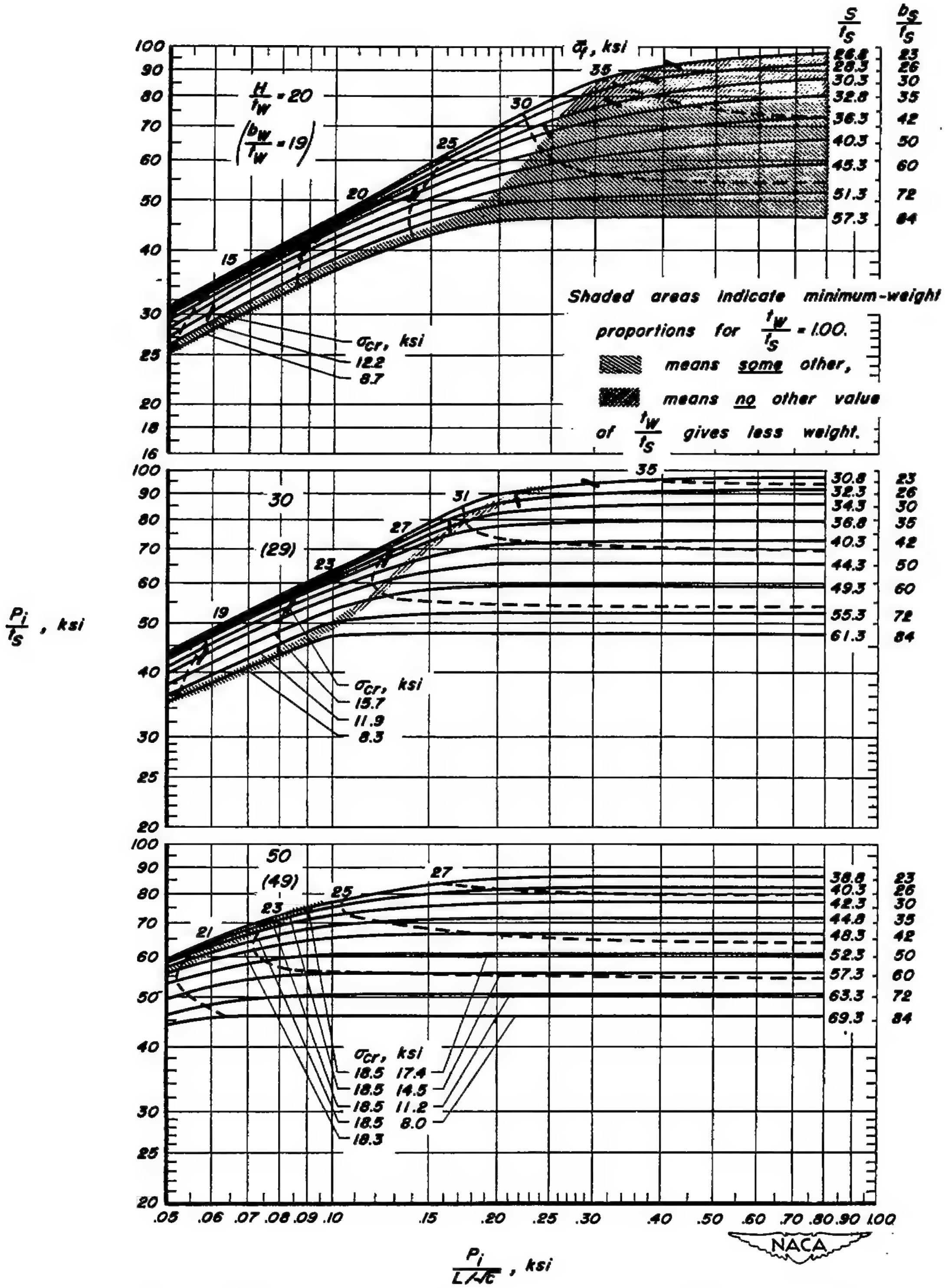



Figure 6.—Direct-reading design chart for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 1.00$.

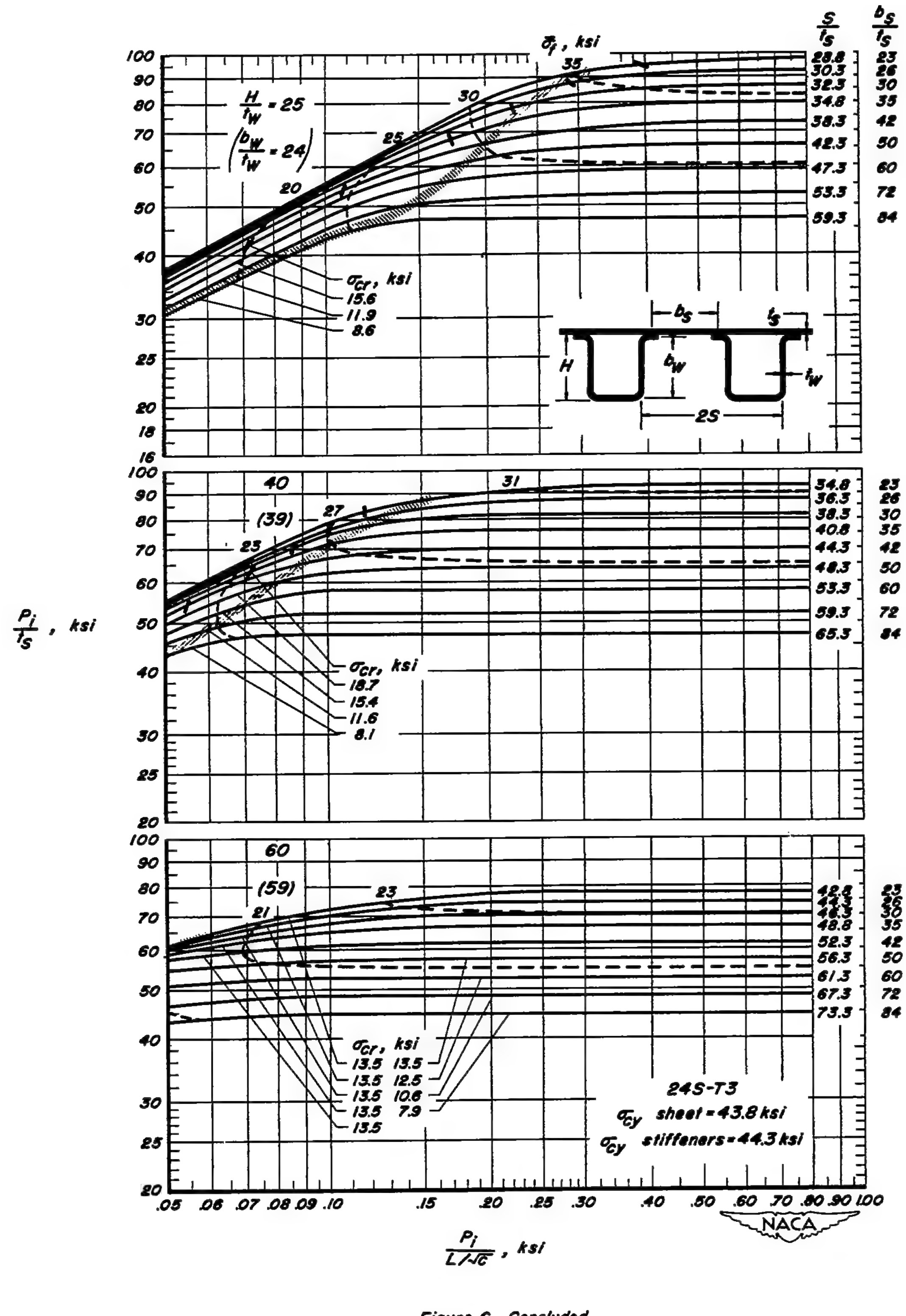



Figure 6.—Concluded

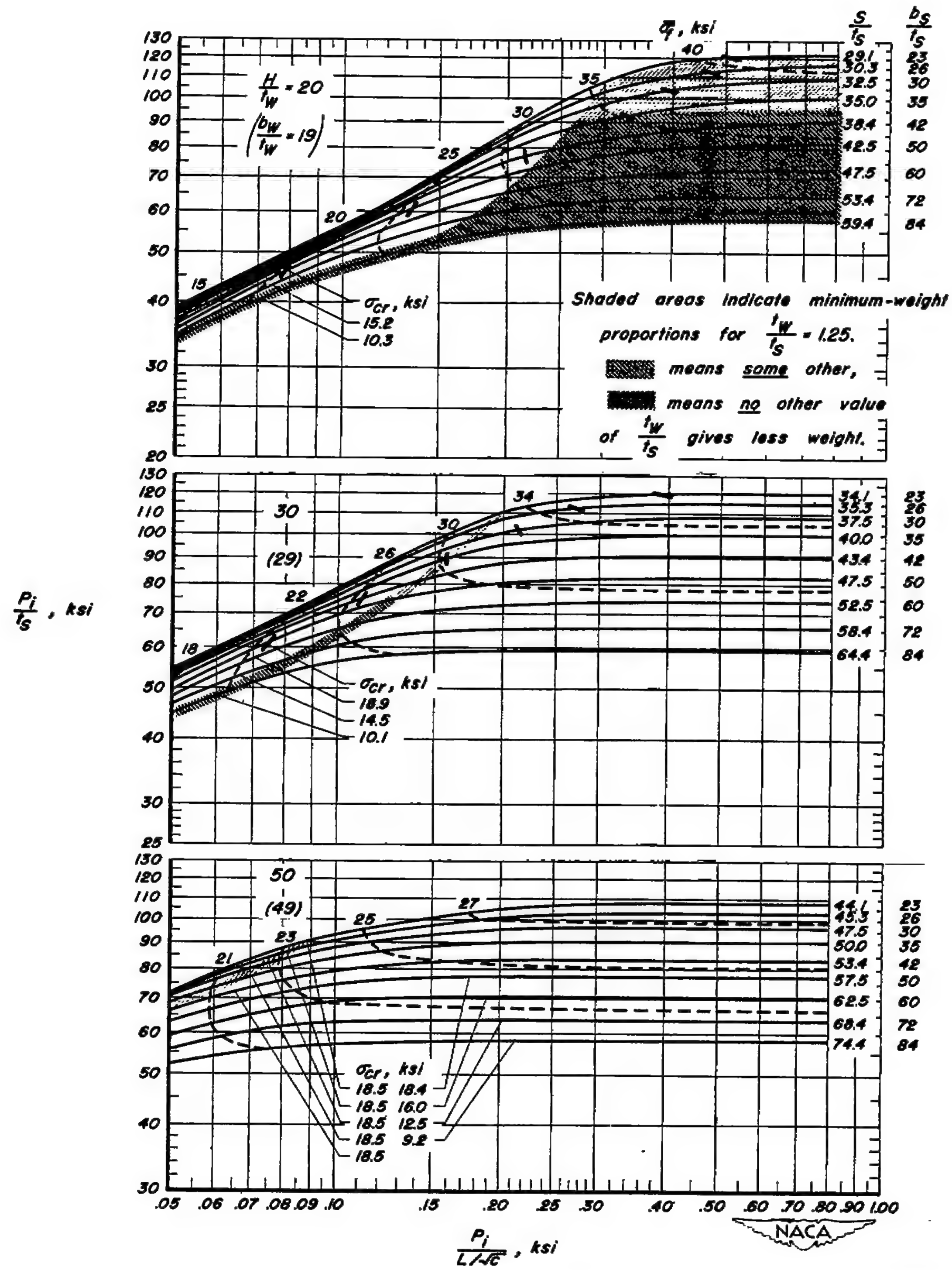



Figure 7.—Direct-reading design chart for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 1.25$.

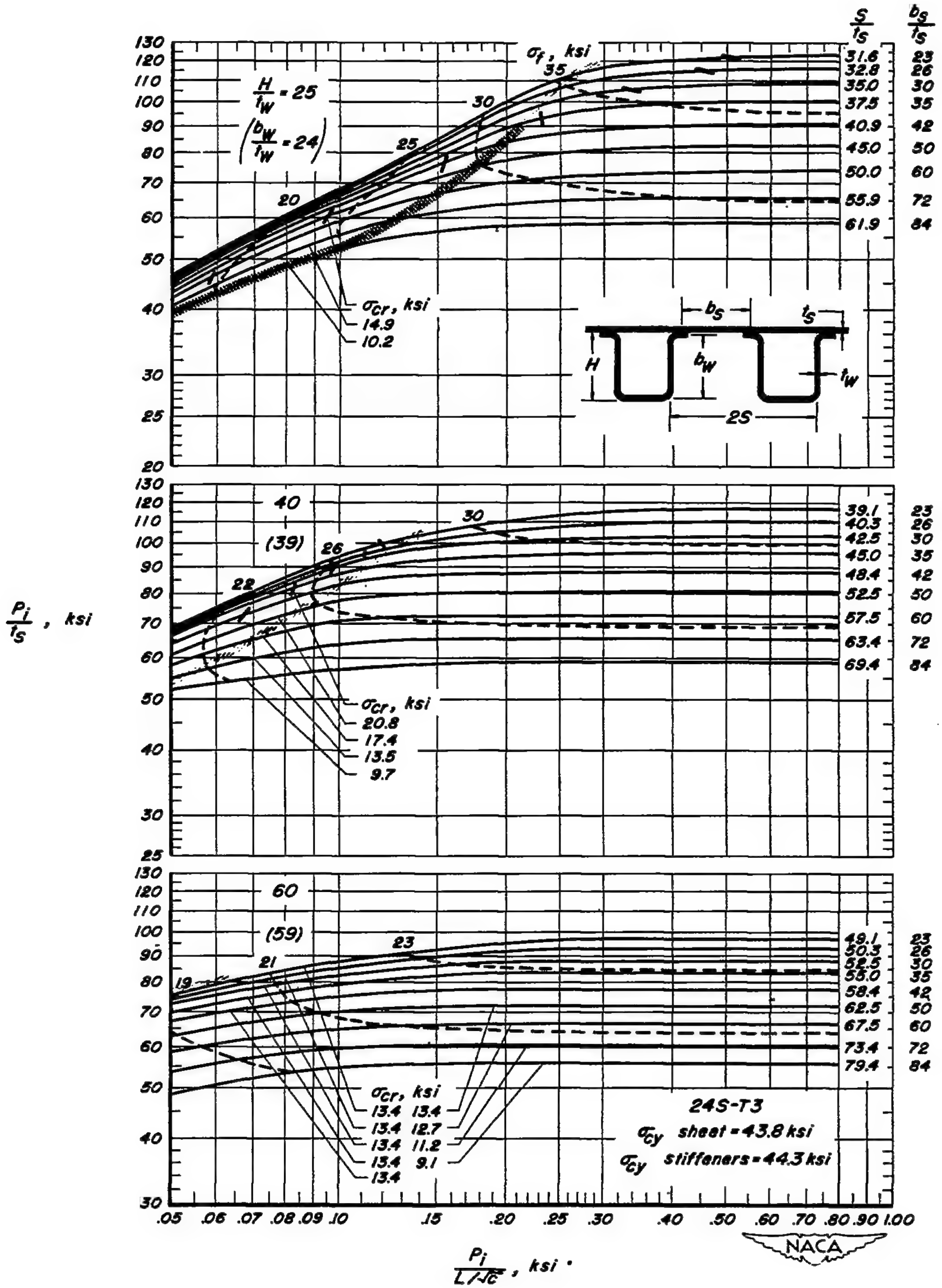



Figure 7 — Concluded

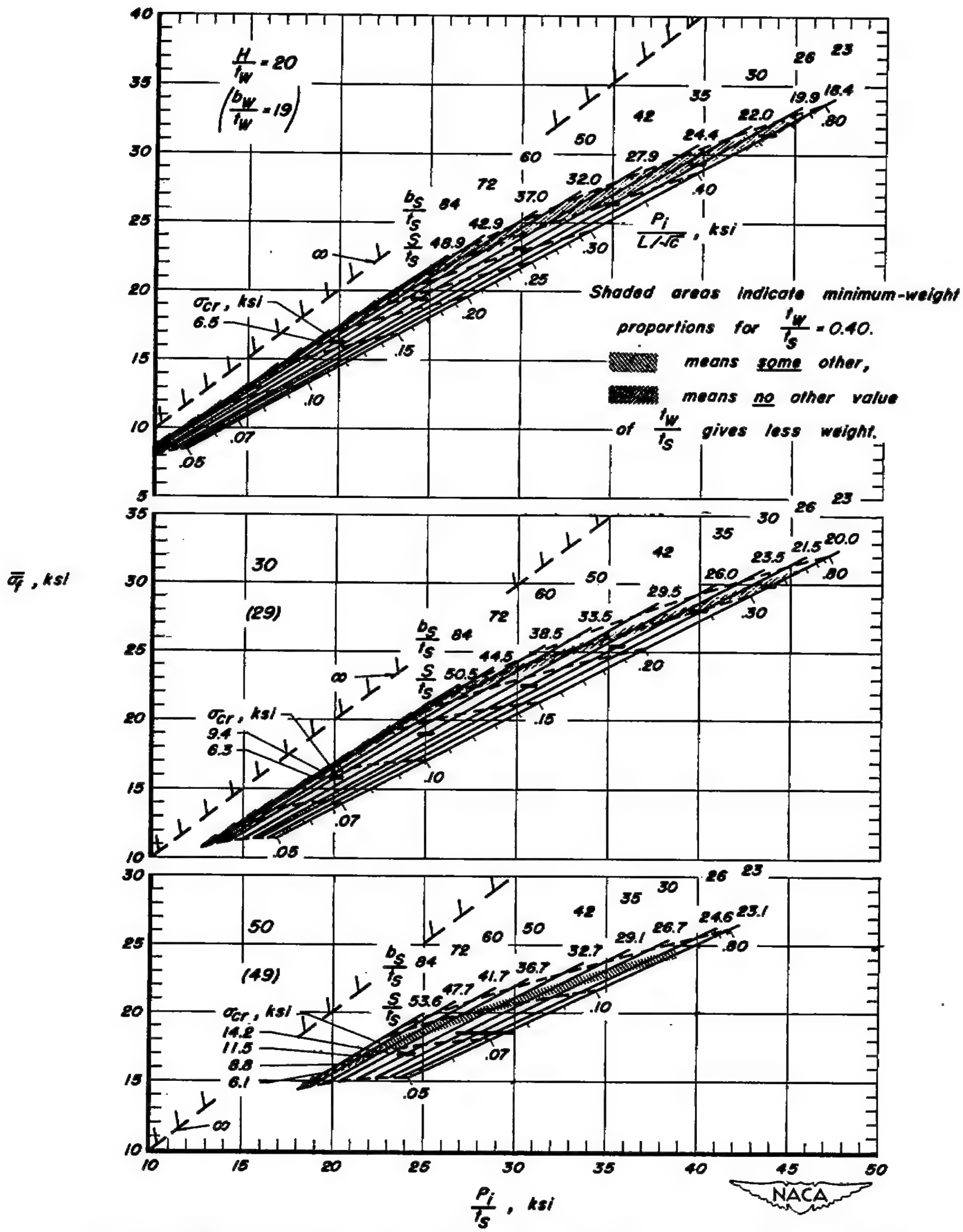



Figure 8.—Direct-reading design chart (alternate form) for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners, $\frac{t_W}{t_S} = 0.40$.

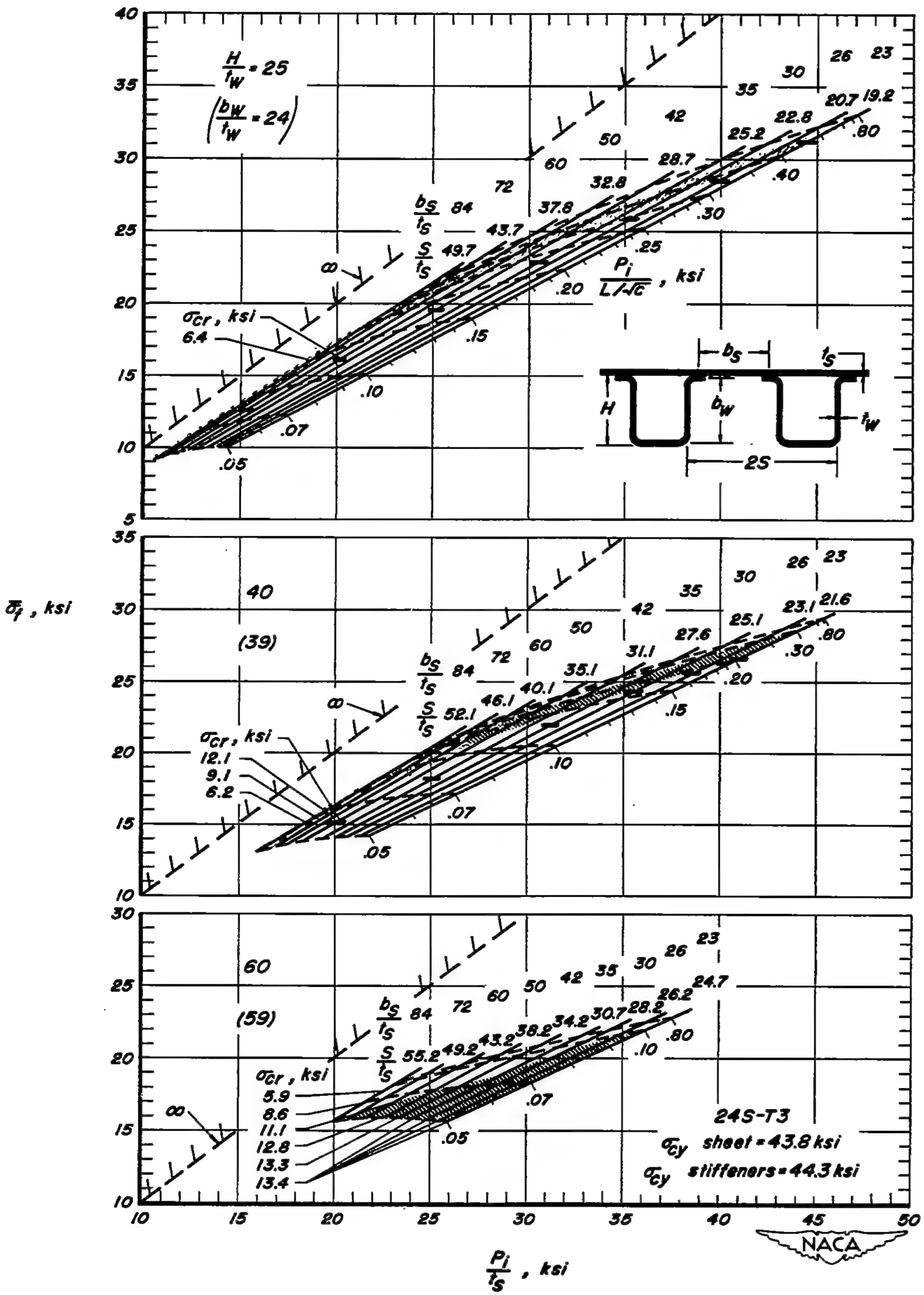



Figure 8.— Concluded

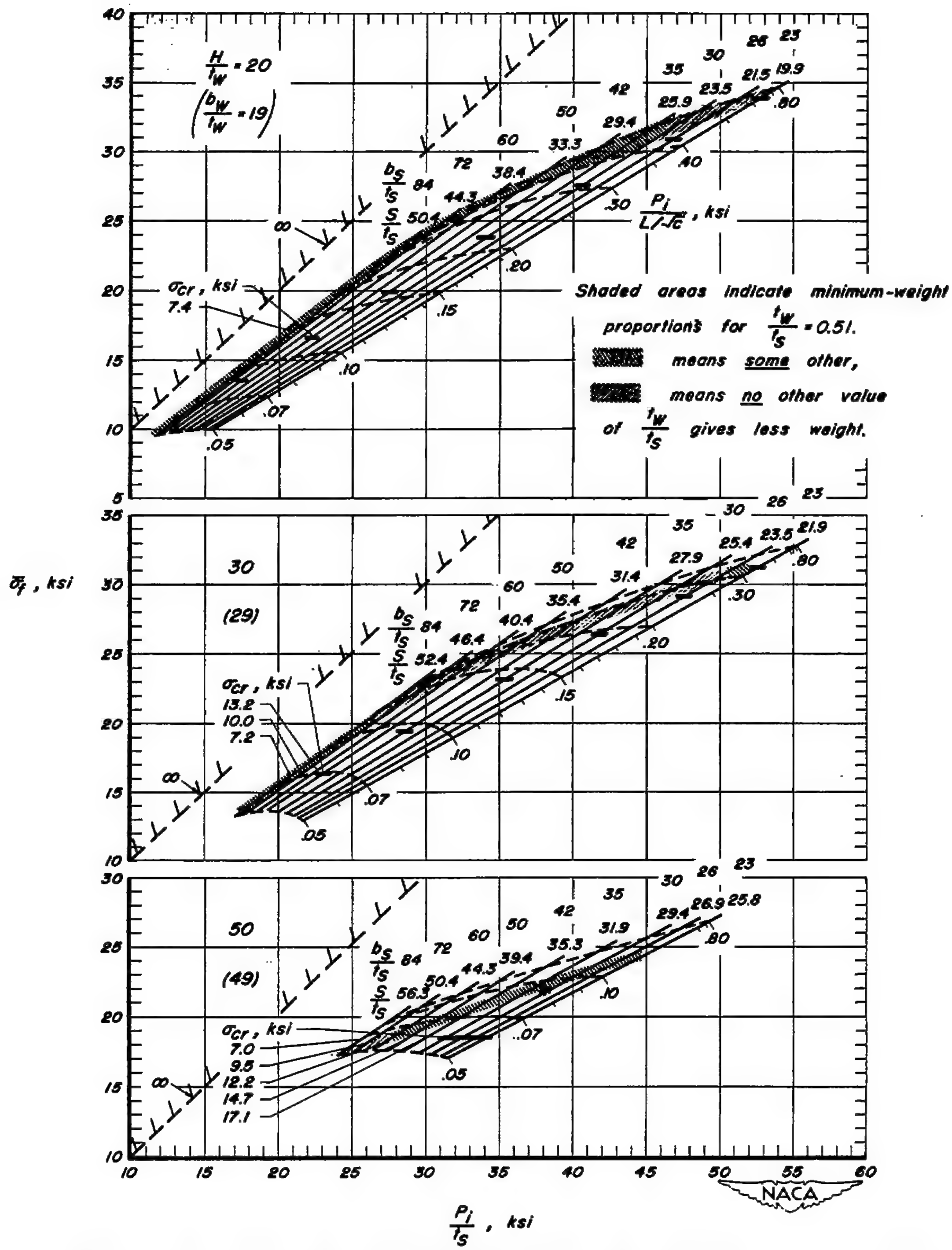



Figure 9.—Direct-reading design chart (alternate form) for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.51$

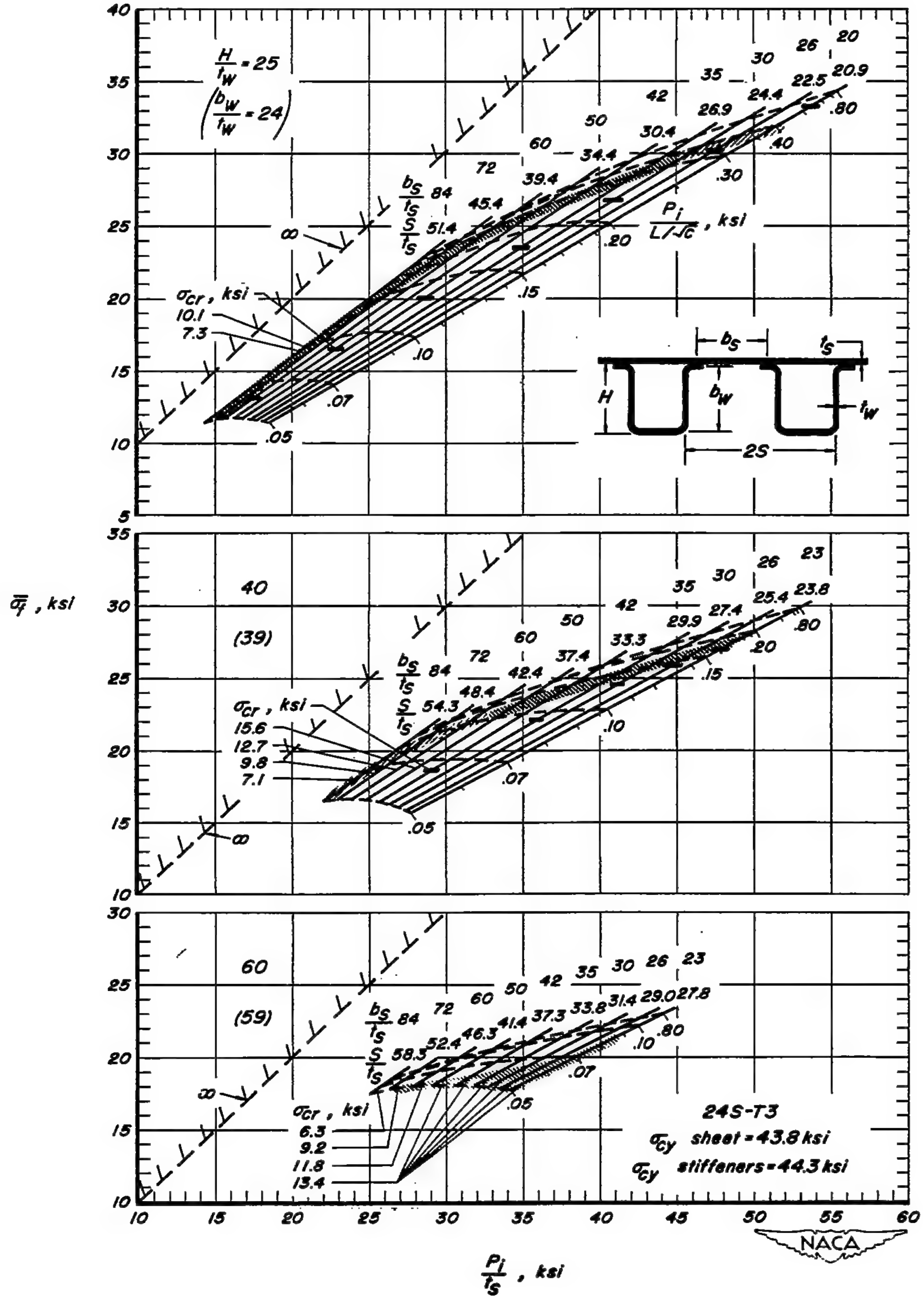



*Figure 9.— Concluded*

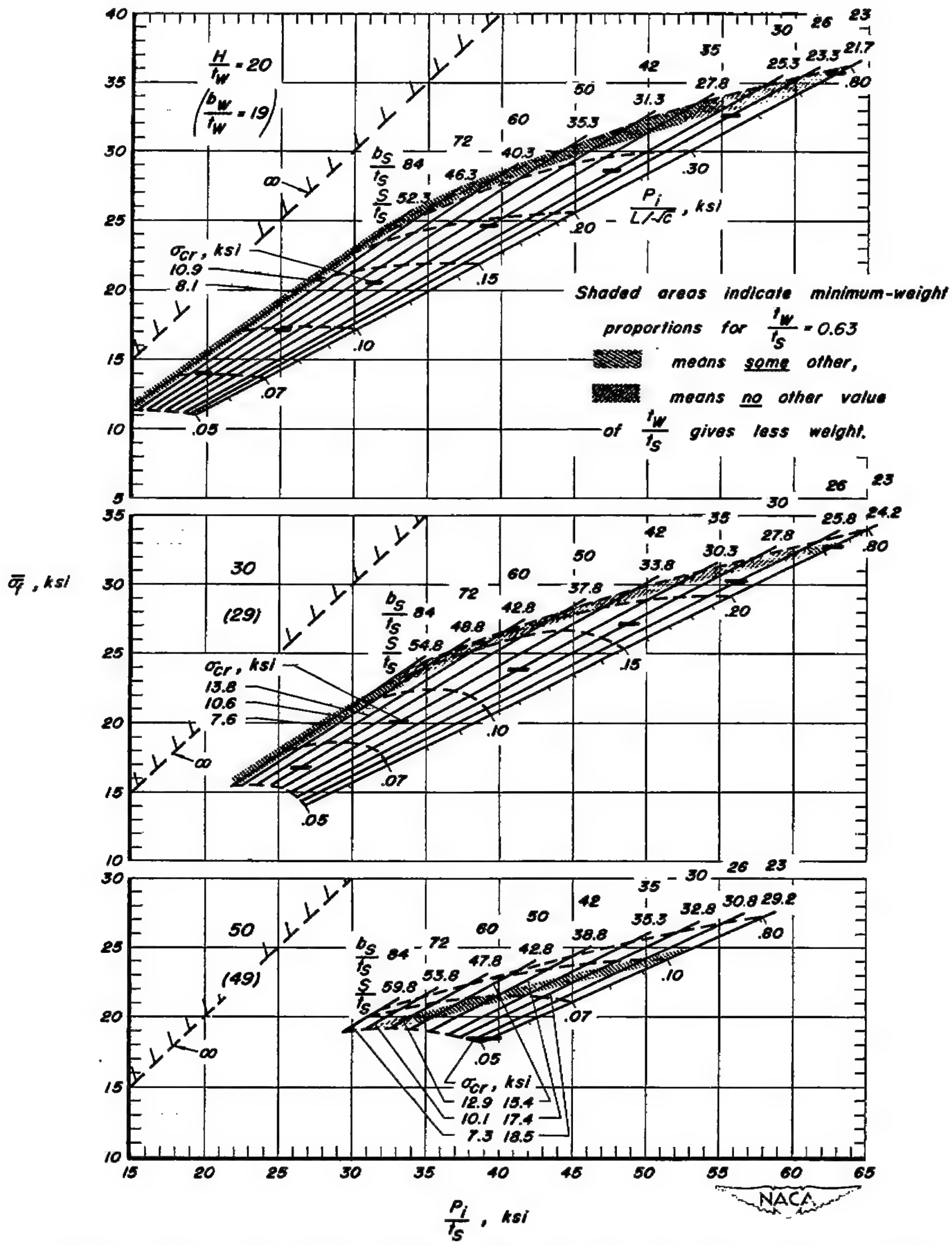



*Figure 10.—Direct-reading design chart (alternate form) for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.63$.*

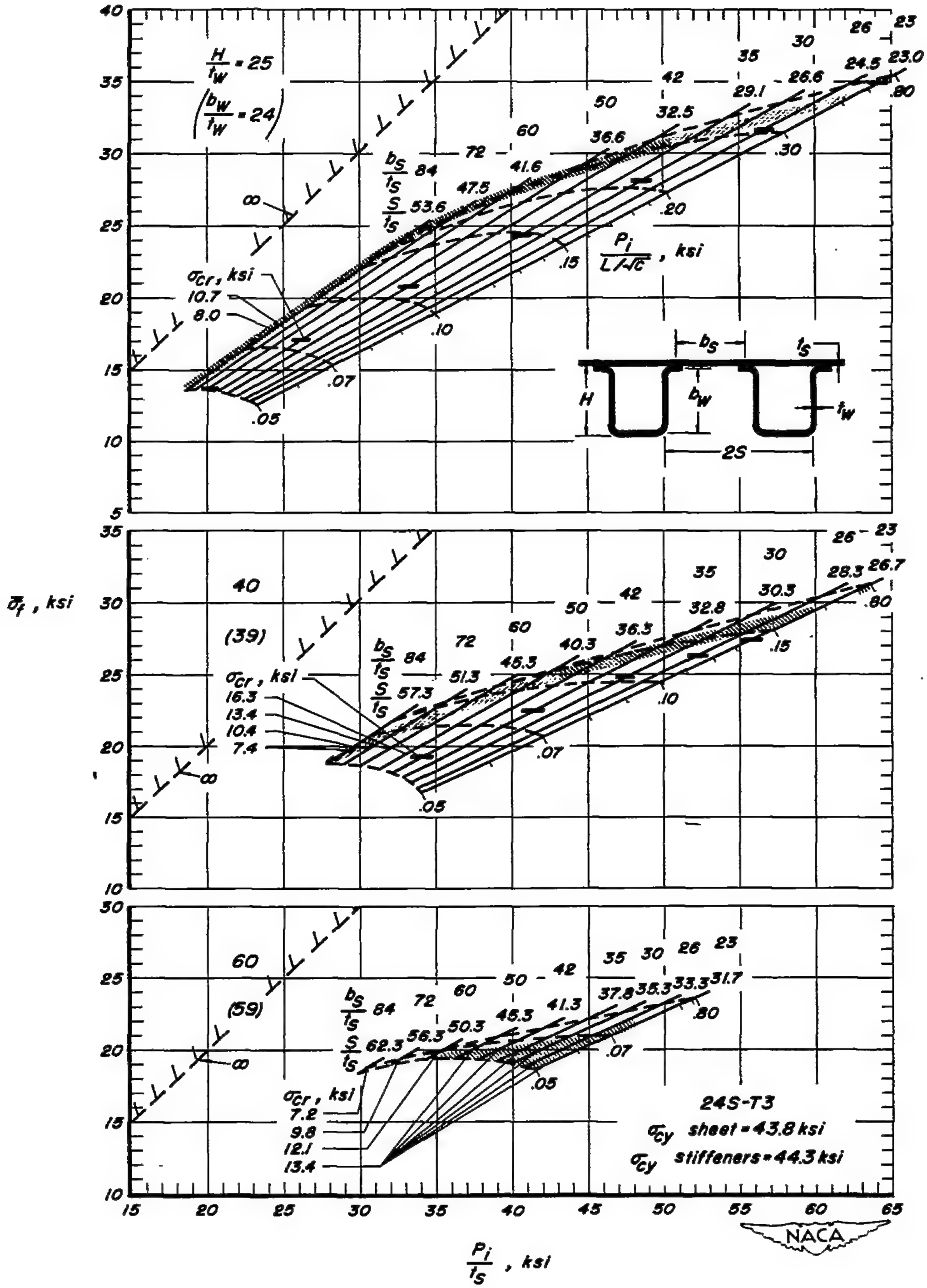



Figure 10.— Concluded

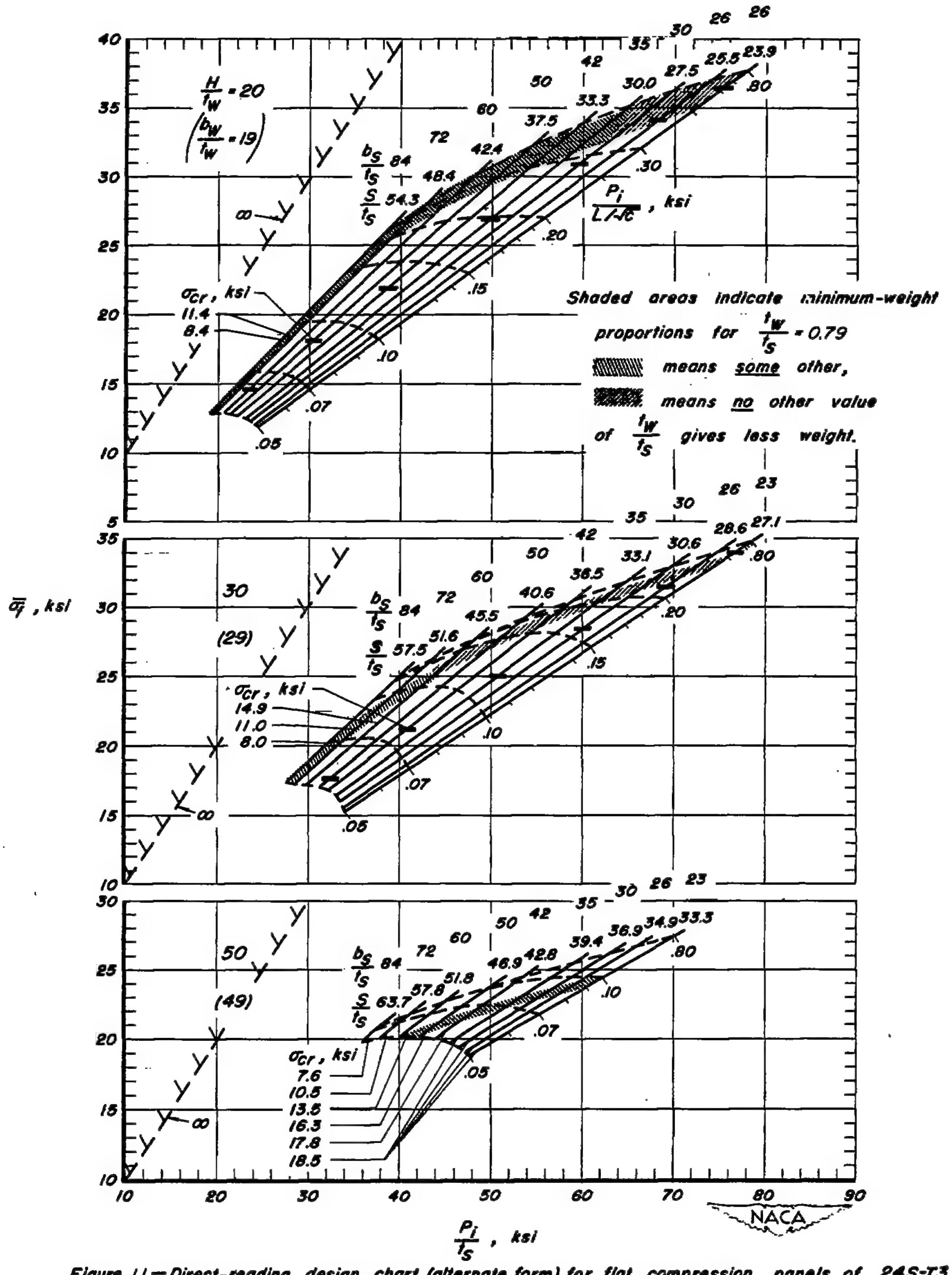



Figure 11.— Direct-reading design chart (alternate form) for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_W}{t_S} = 0.79$.

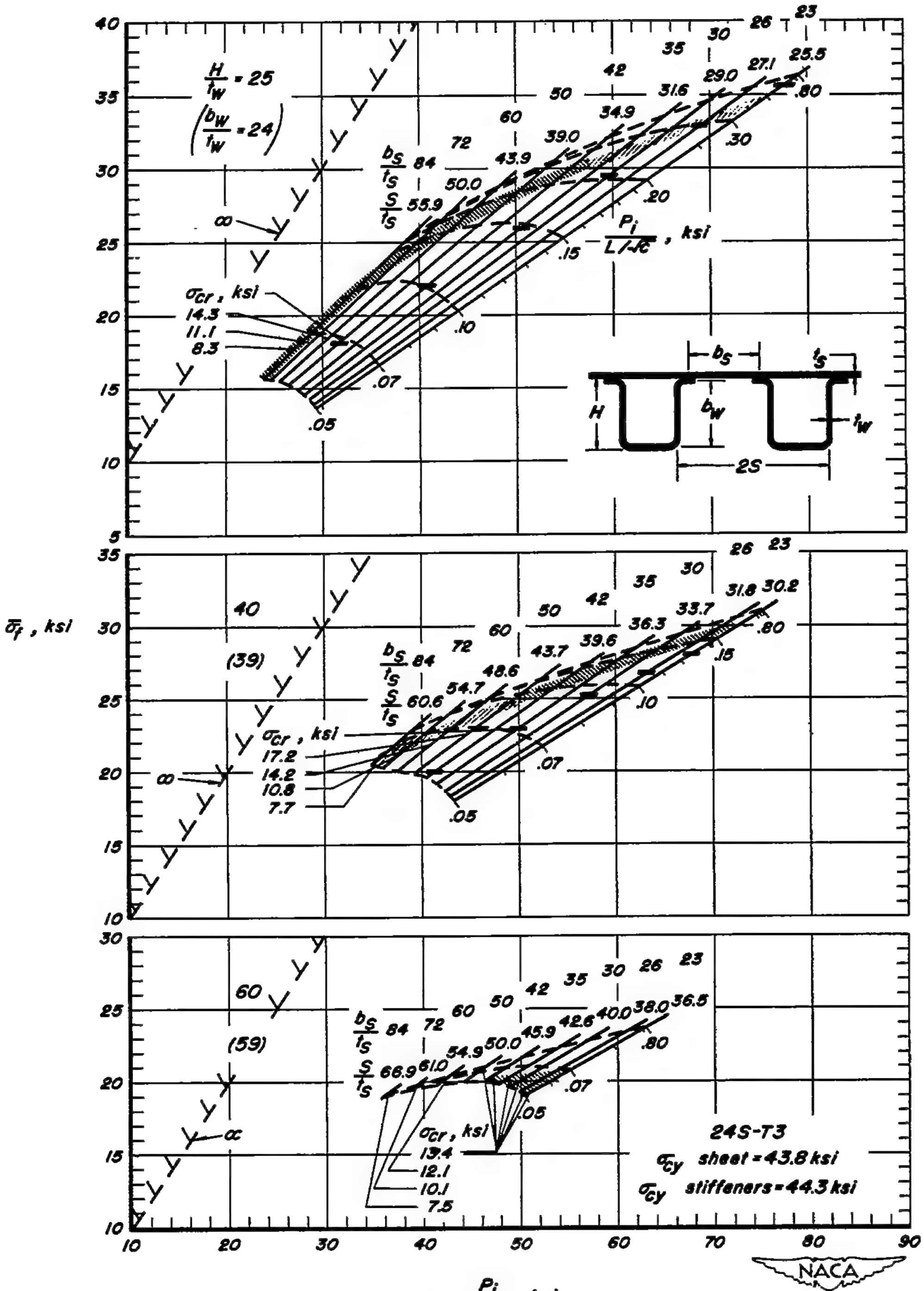



Figure 11.— Concluded

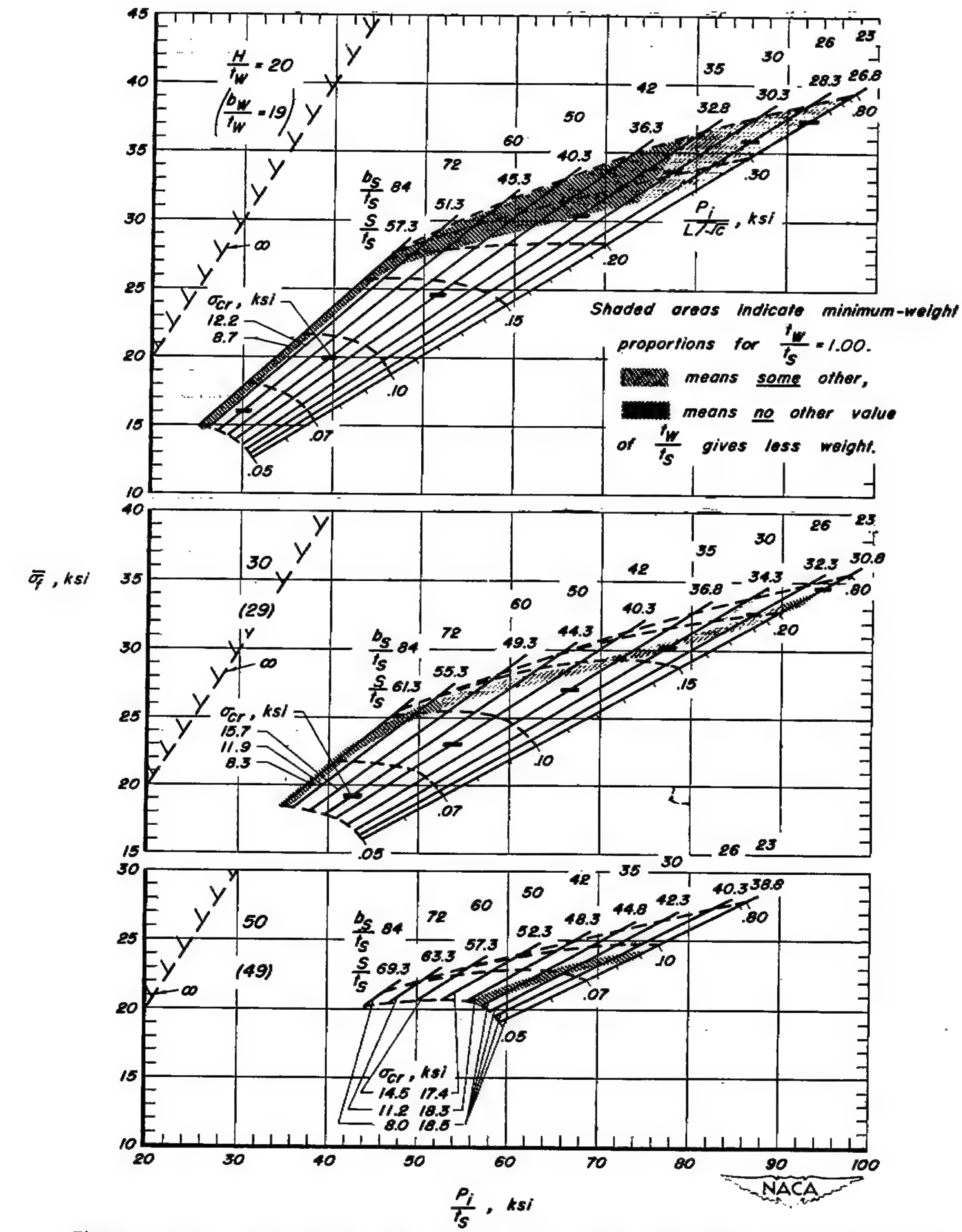



*Figure 12.—Direct-reading design chart (alternate form) for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners. $\frac{t_w}{t_S}$ = 1.00.*

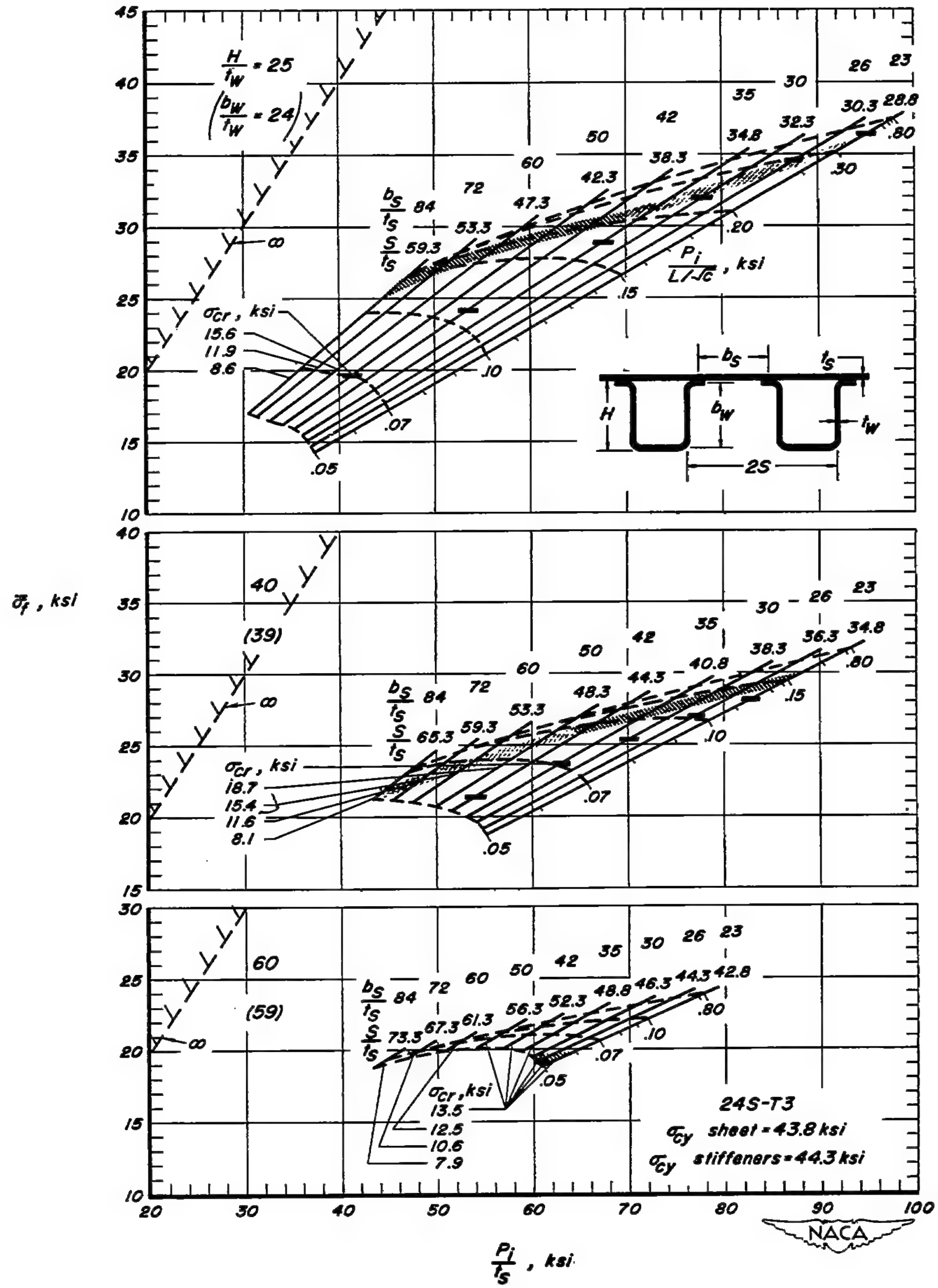



Figure 12.— Concluded

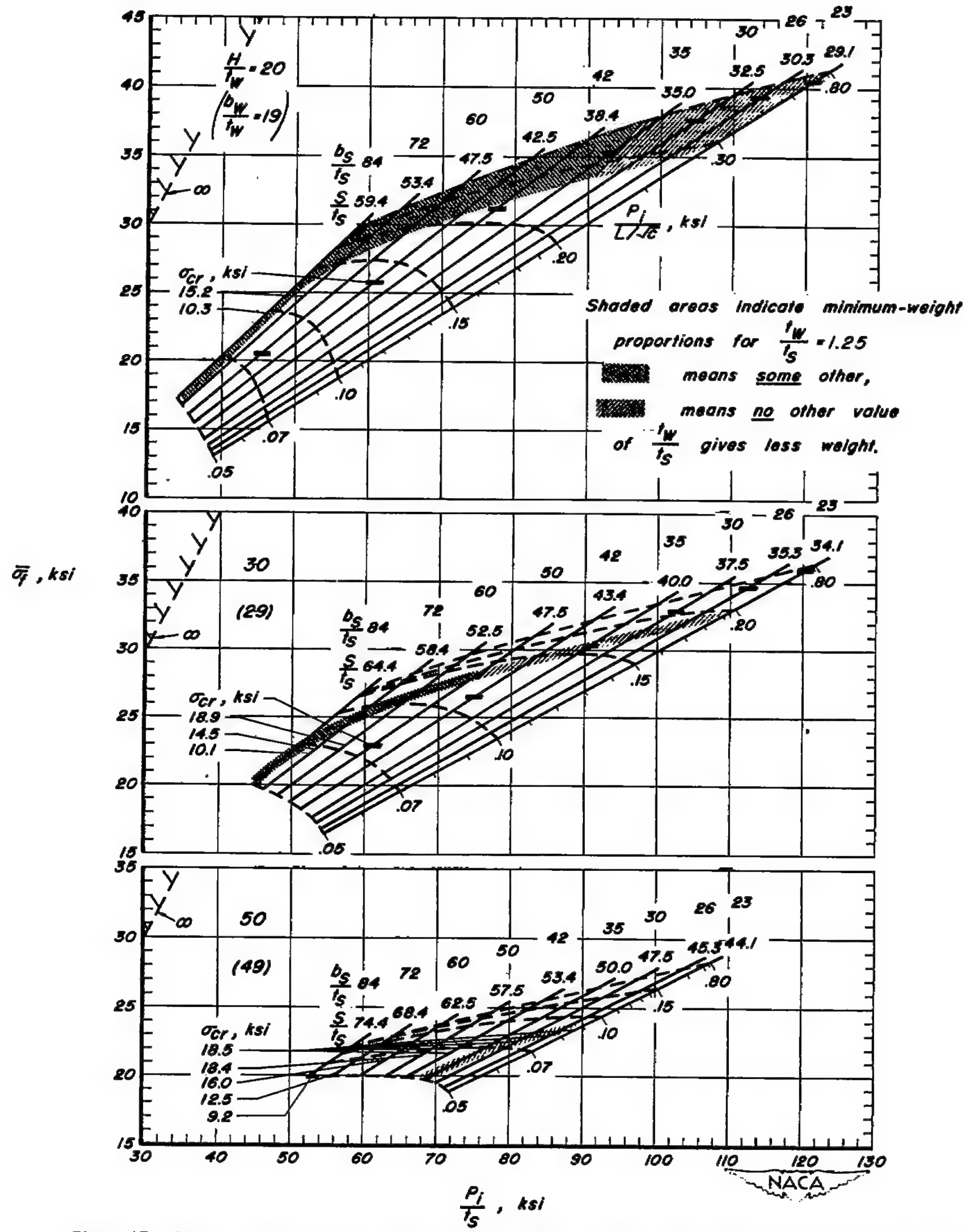



*Figure 13.—Direct-reading design chart (alternate form) for flat compression panels of 24S-T3 aluminum alloy with formed hat-section stiffeners.* $\frac{t_W}{t_S} = 1.25$

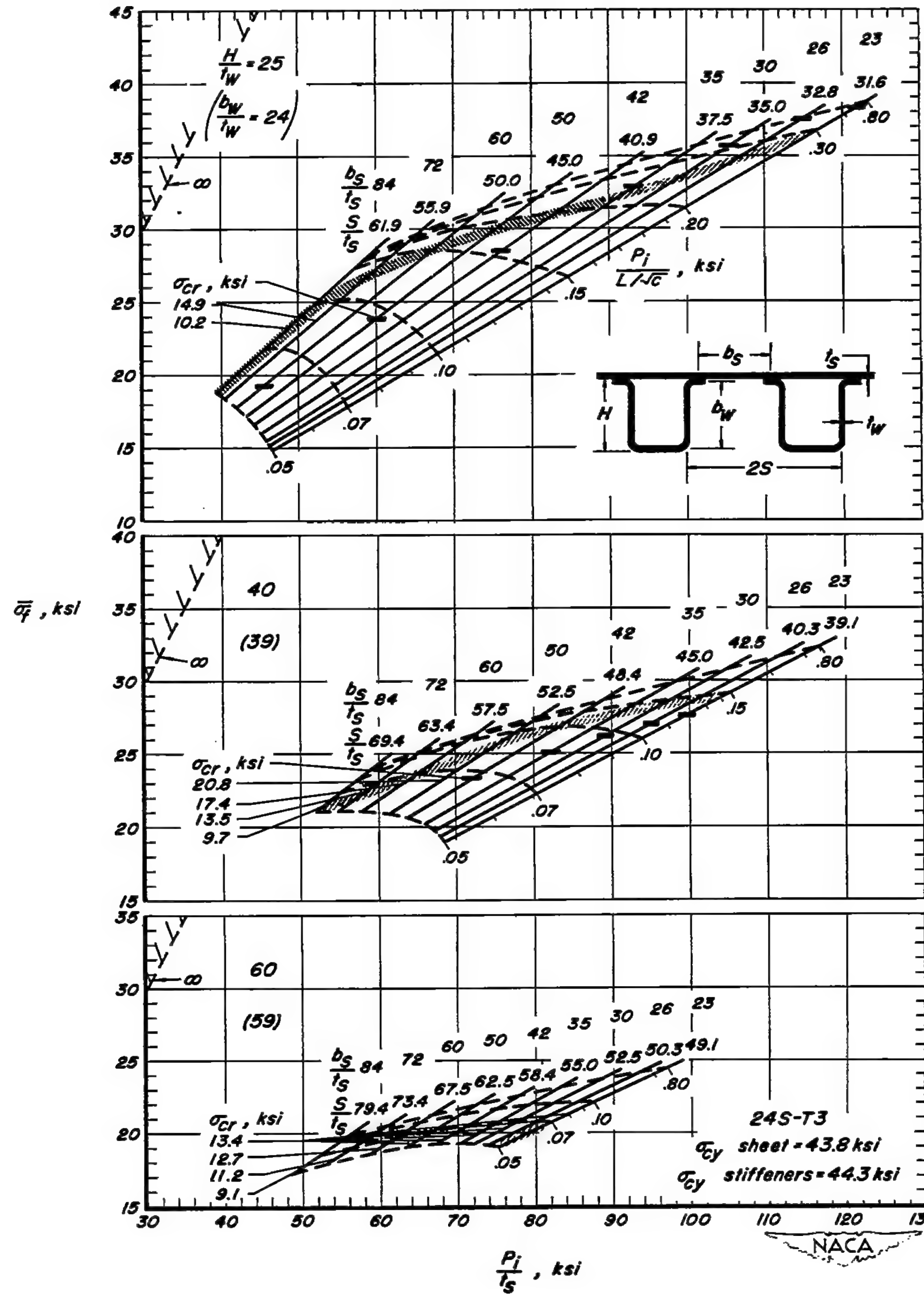
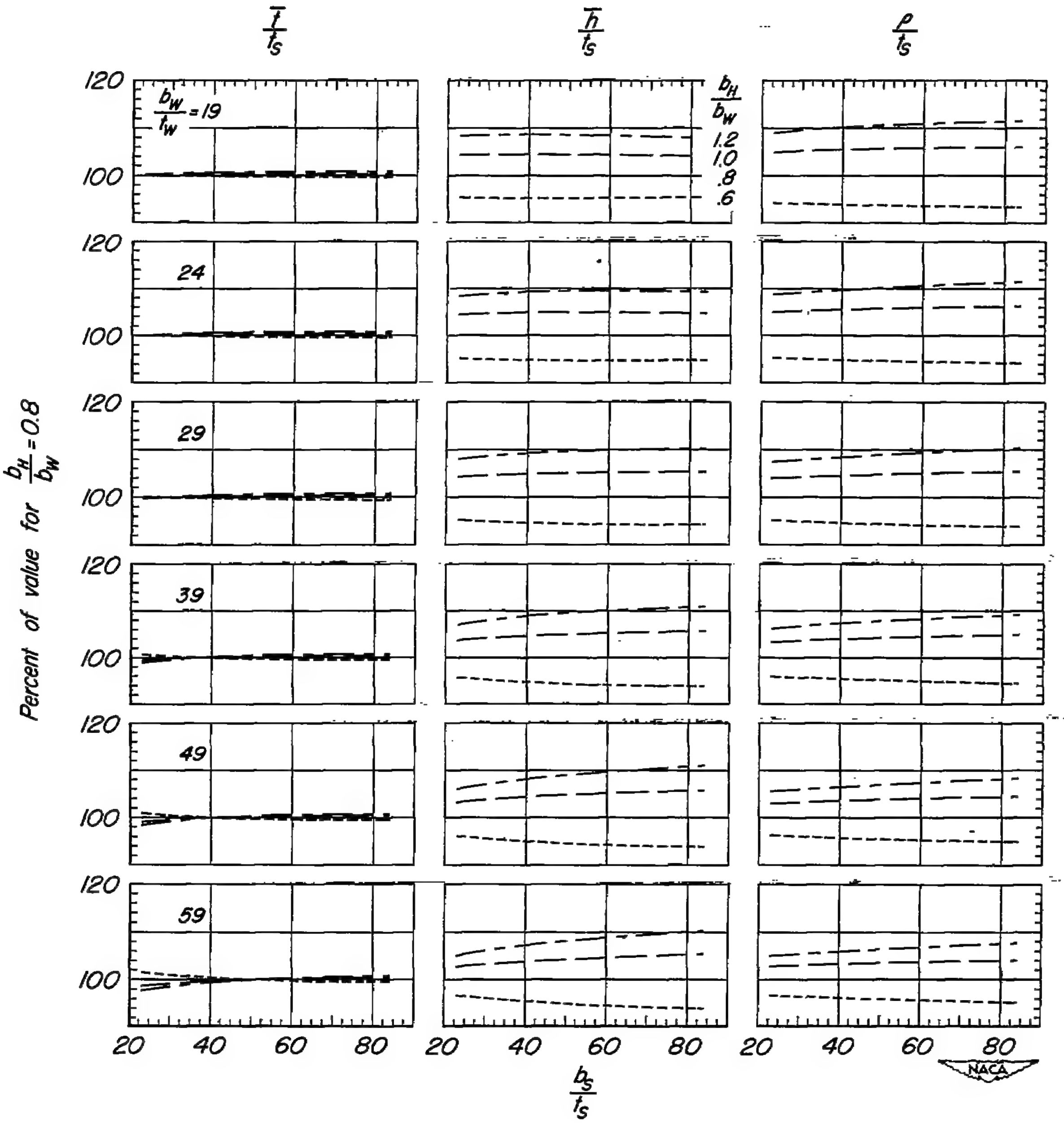
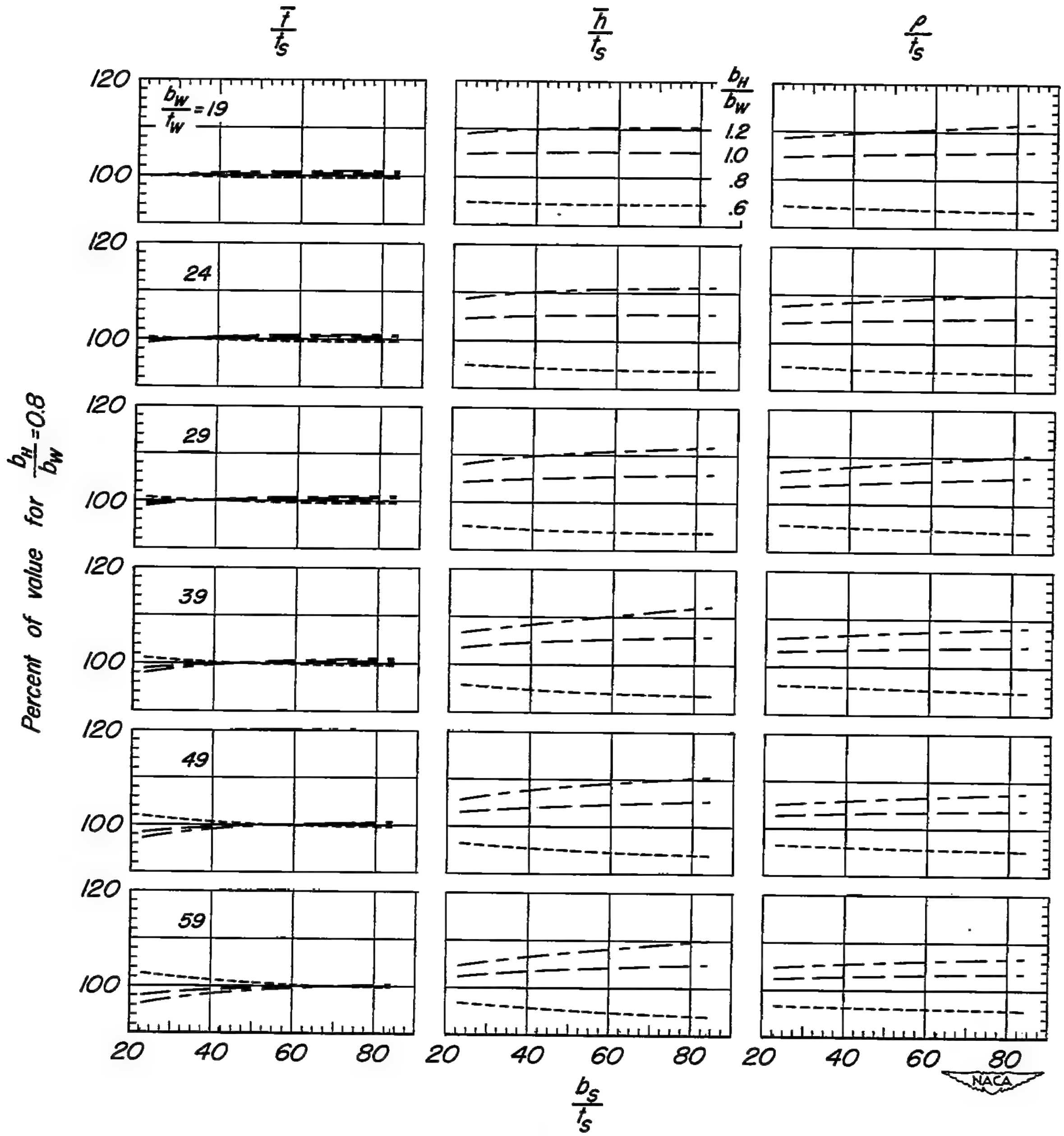



Figure 13.— Concluded



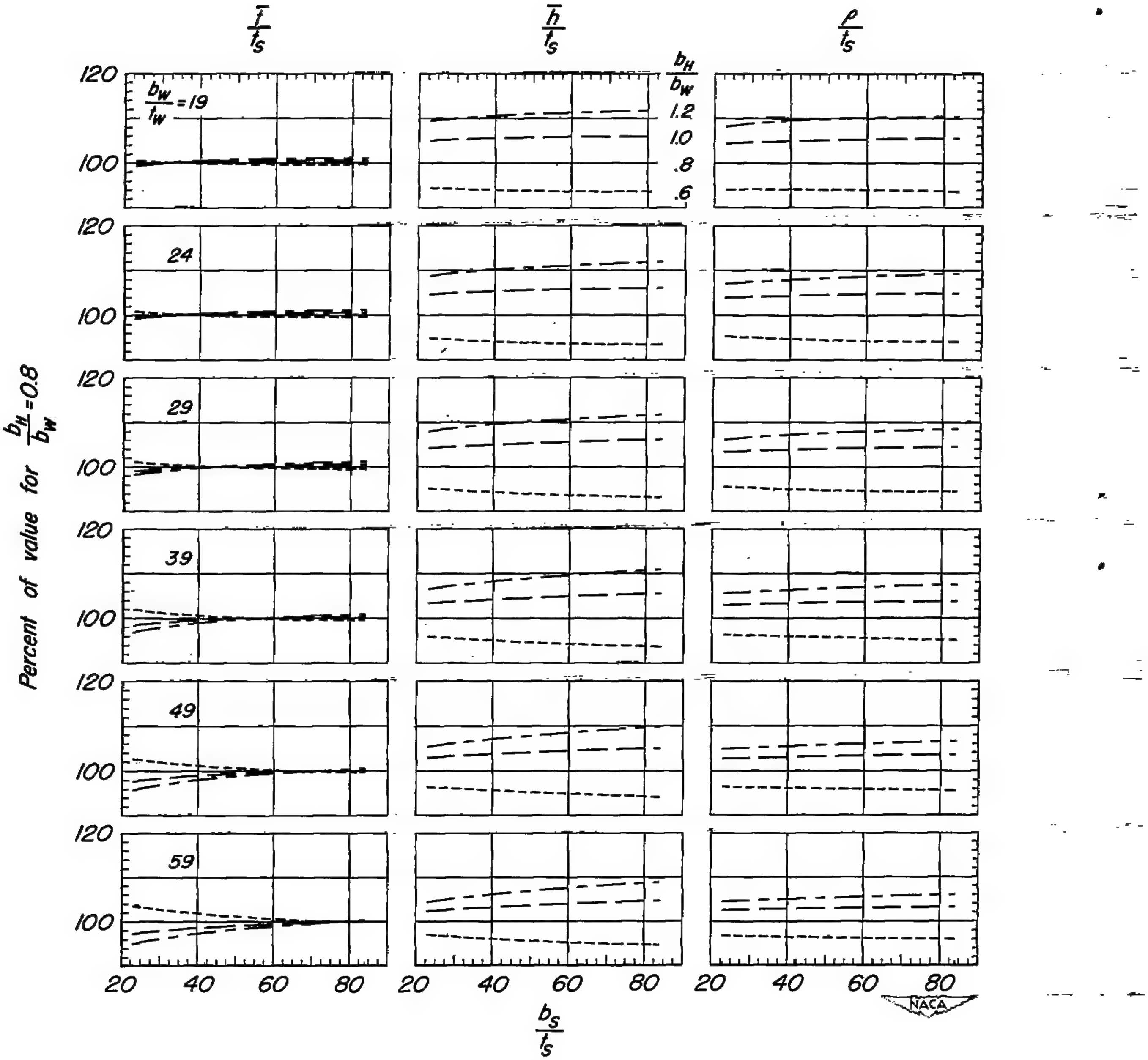

(a) $\frac{t_W}{t_S} = 0.40.$

Figure 14.— Effect of variation in $\frac{b_H}{b_W}$ on section properties.



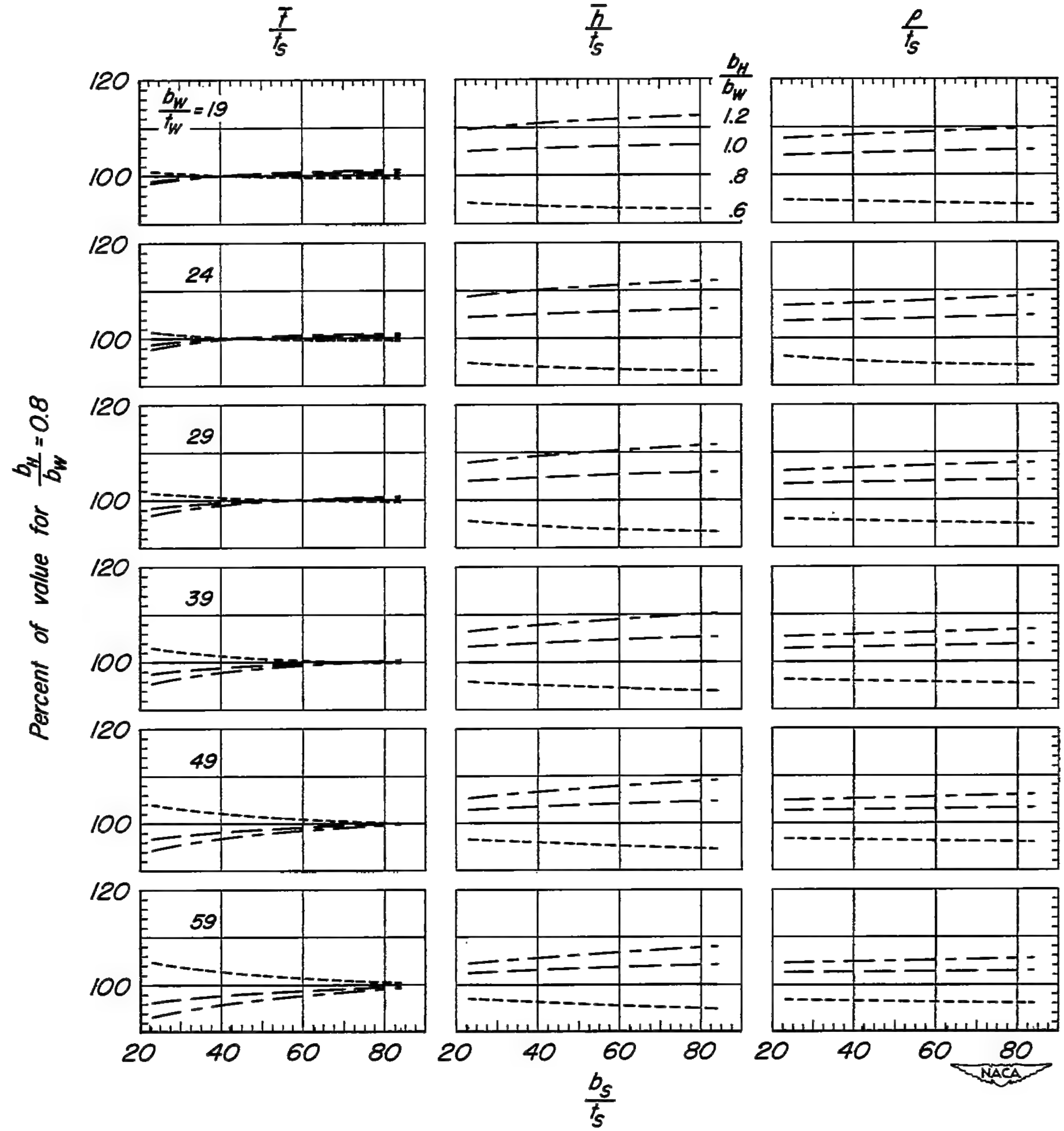

(b) $\frac{t_W}{t_S}=0.51.$

Figure 14.– Continued.



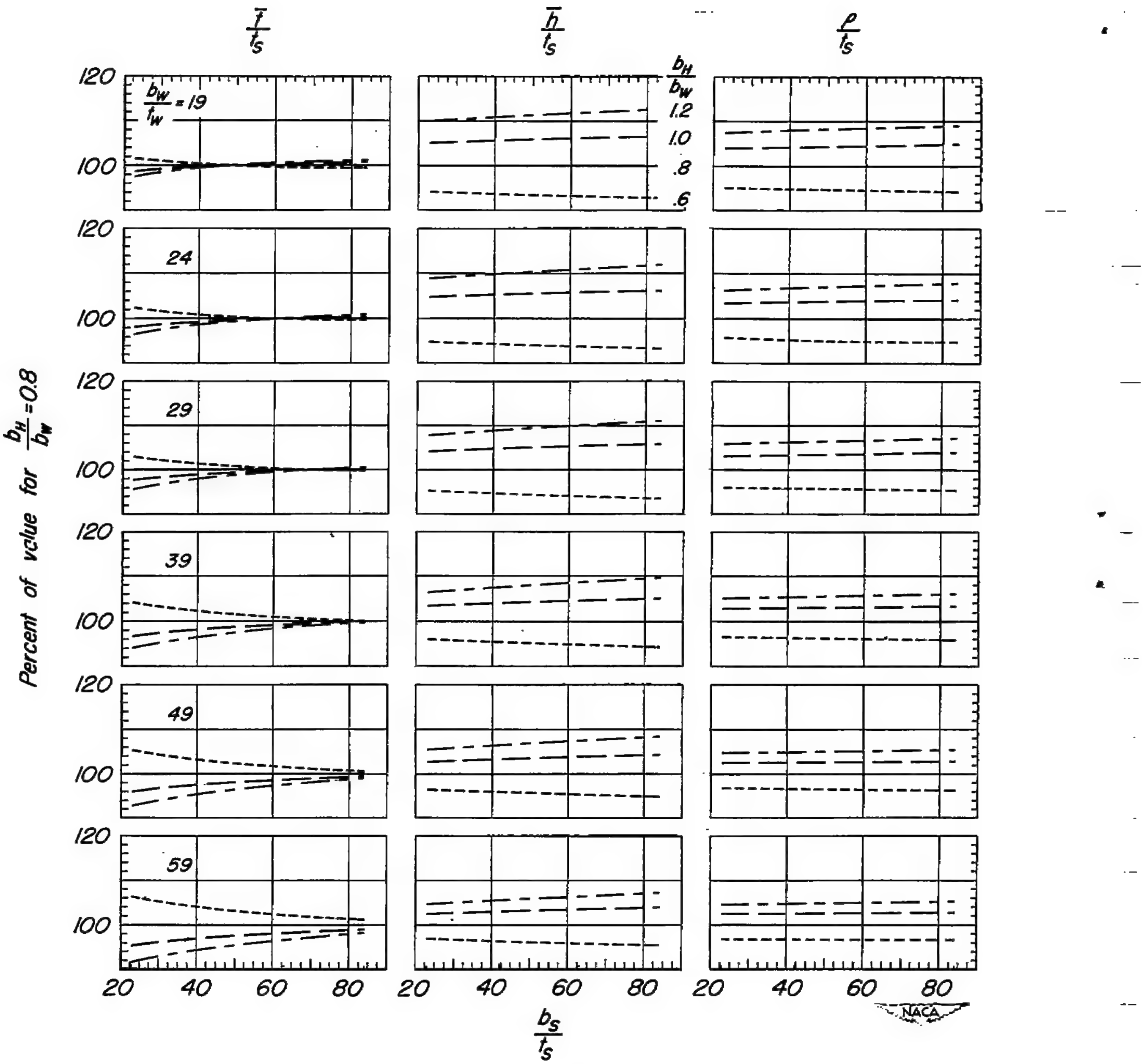

(c) $\frac{t_W}{t_S} = 0.63.$

Figure 14.—Continued.



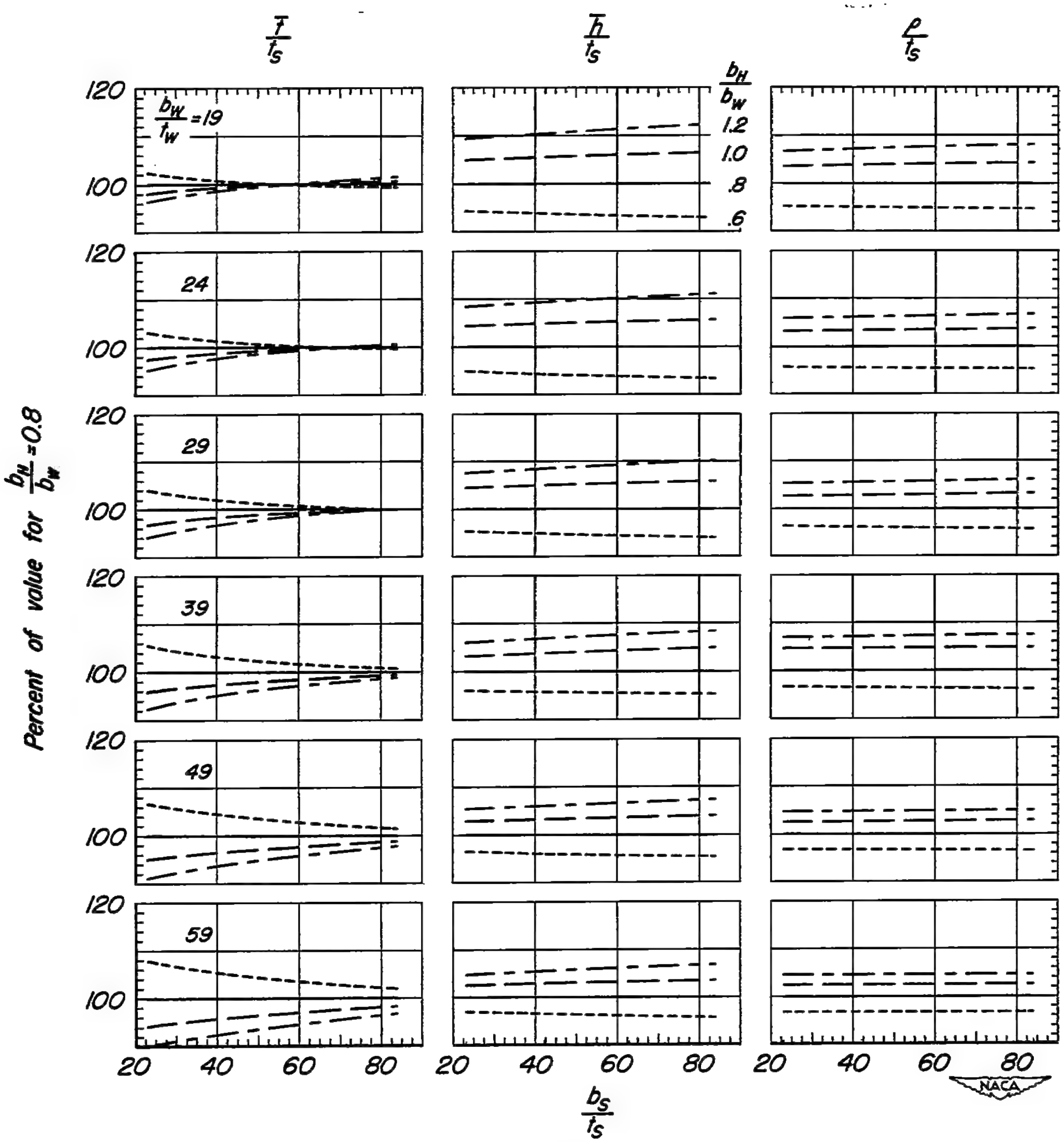

(d) $\frac{t_W}{t_S} = 0.79.$

Figure 14.– Continued.




(e) $\frac{t_W}{t_S}$ = 1.00.

Figure 14.—Continued.




(f) $\frac{t_W}{t_S} = 1.25$.

Figure 14.– Concluded.

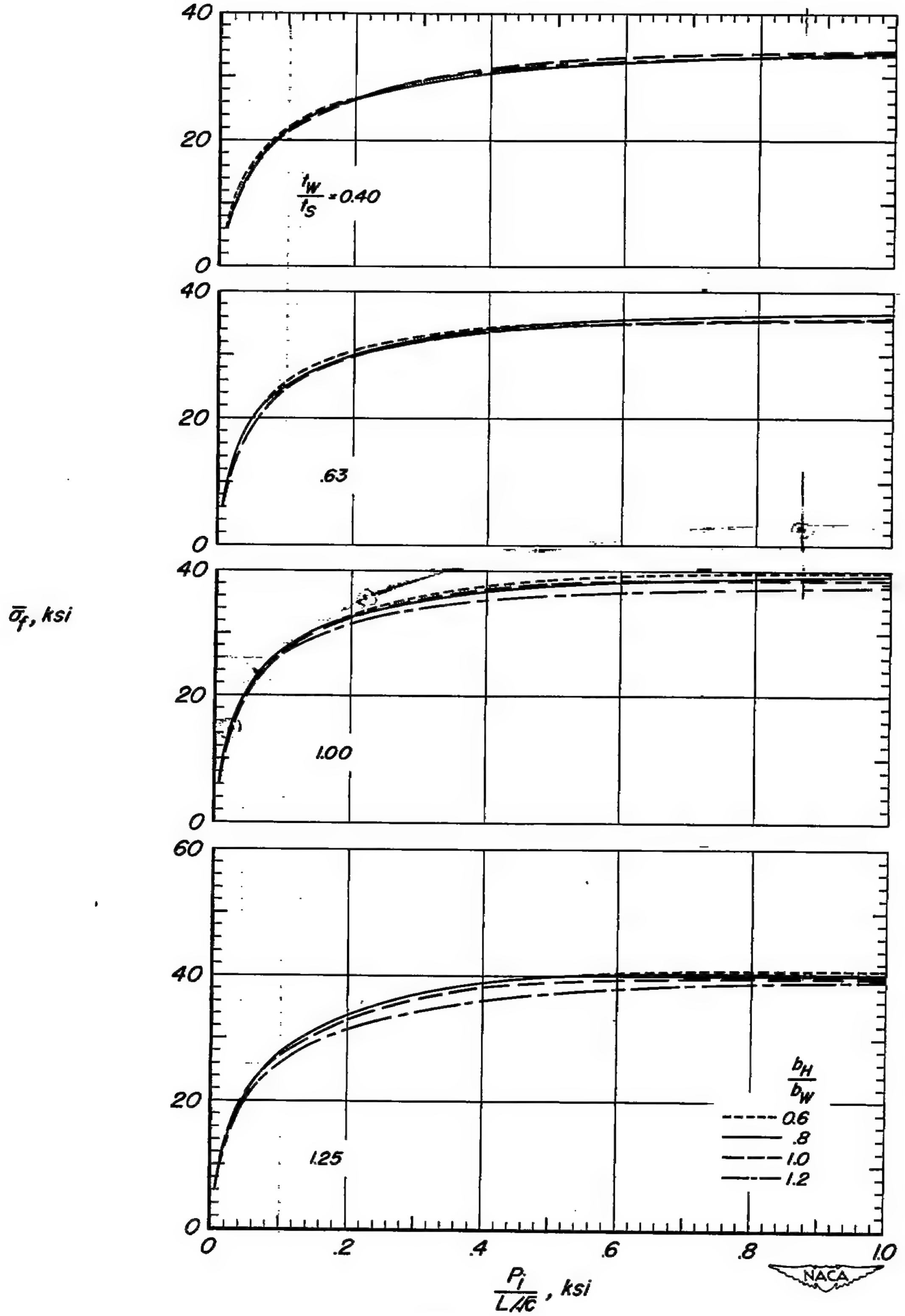



Figure 15.—Highest values of average stress at failure for 24S-T3 aluminum-alloy flat compression panels having formed hat-section stiffeners.

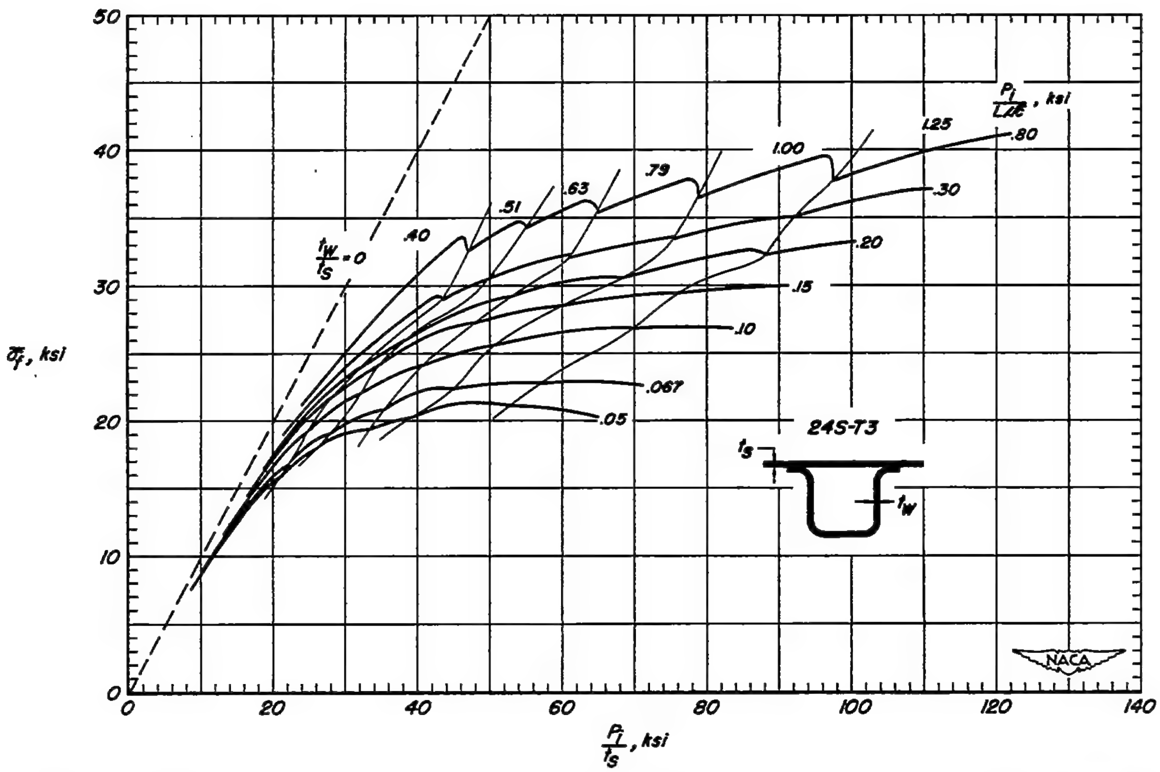



*Figure 16.—Design chart for the determination of the average stress at failure that can be carried by minimum-weight designs of 24S-T3 aluminum-alloy flat compression panels having formed hat-section stiffeners.*

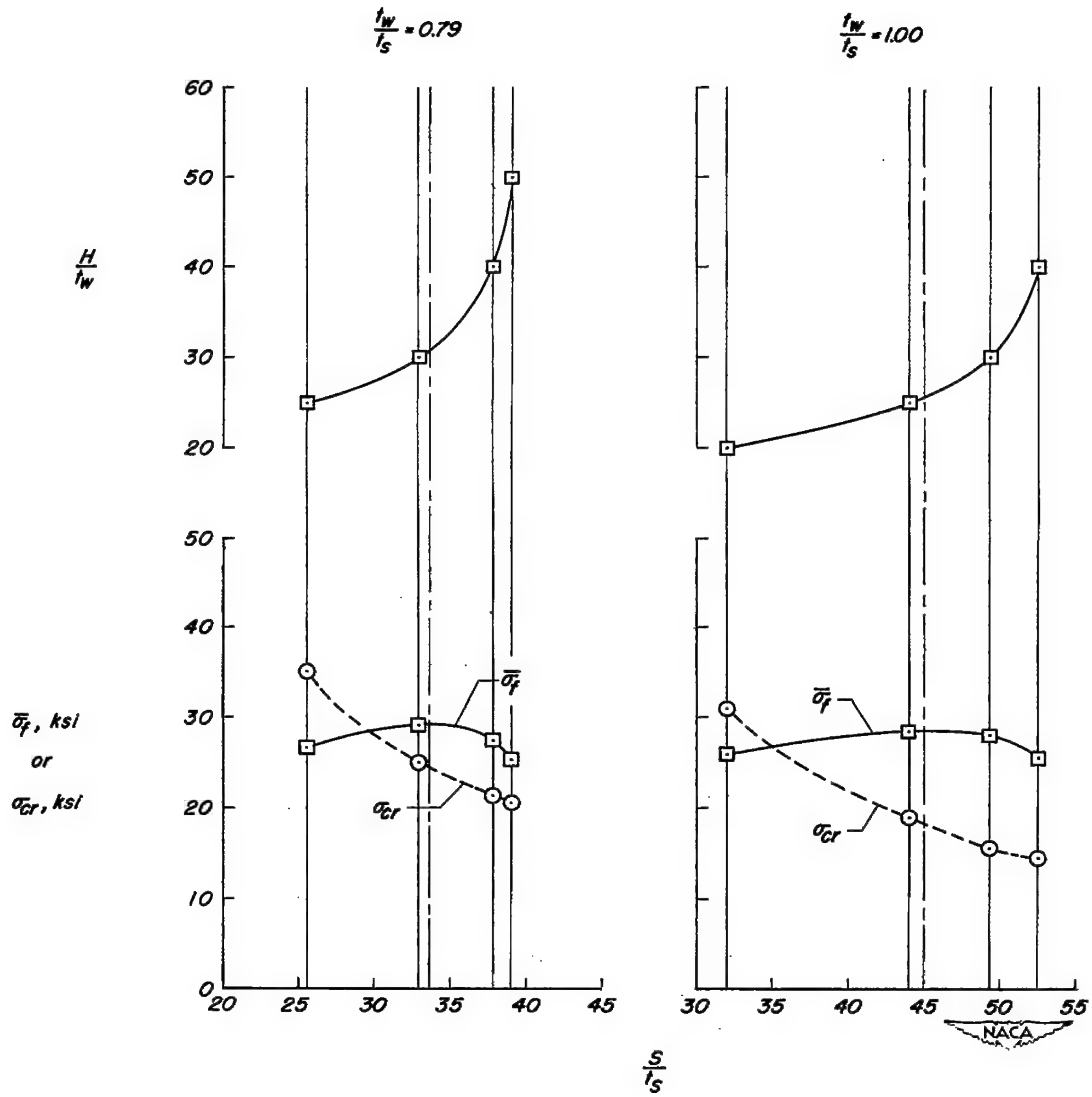



*Figure 17.— Plot for obtaining design from design charts.*

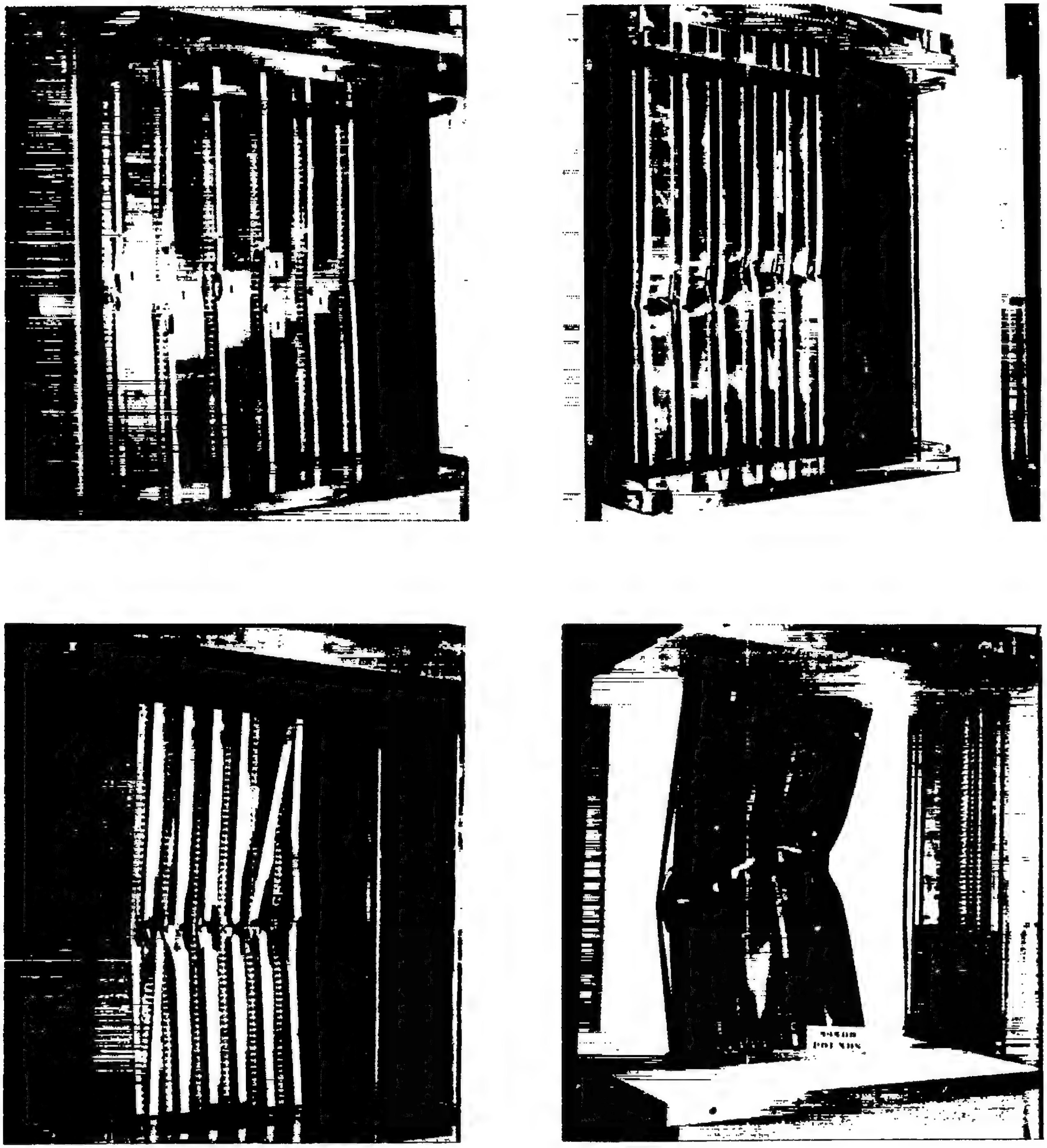


Figure 18.- Typical failure of Z-stiffened panels.

L-75142

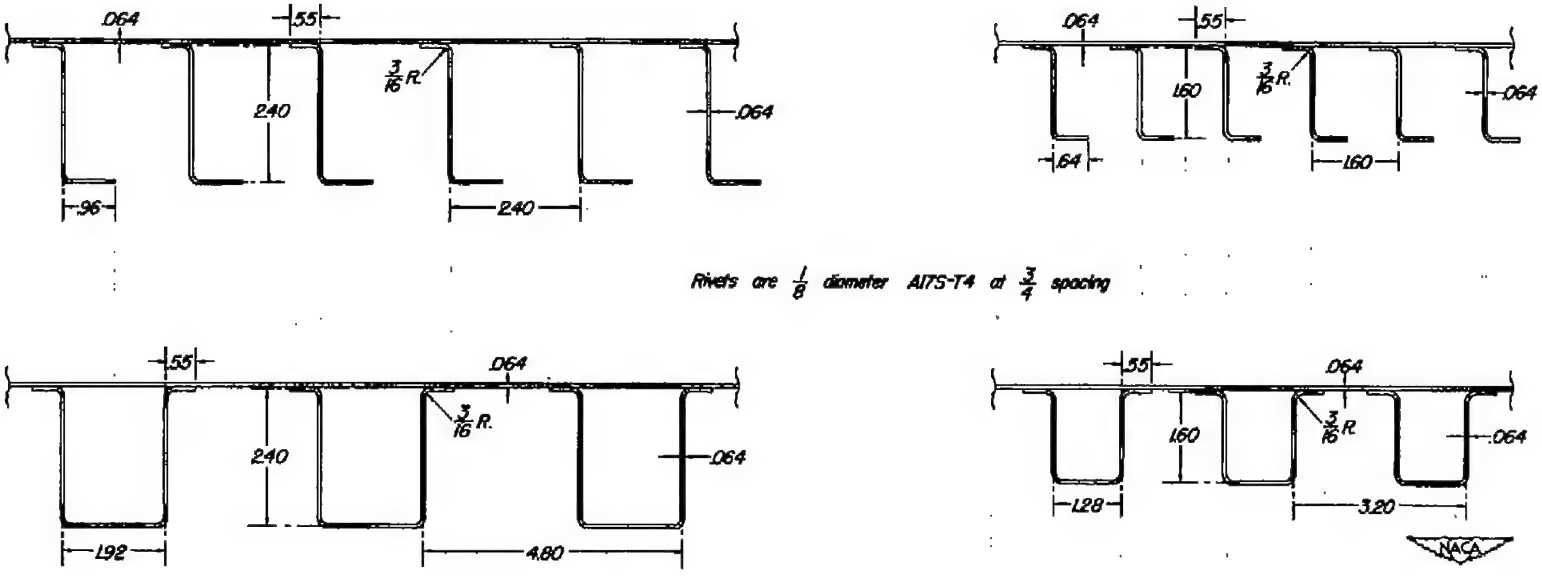



Figure 19.—Dimensions of comparative hat- and Z-stiffened panels.

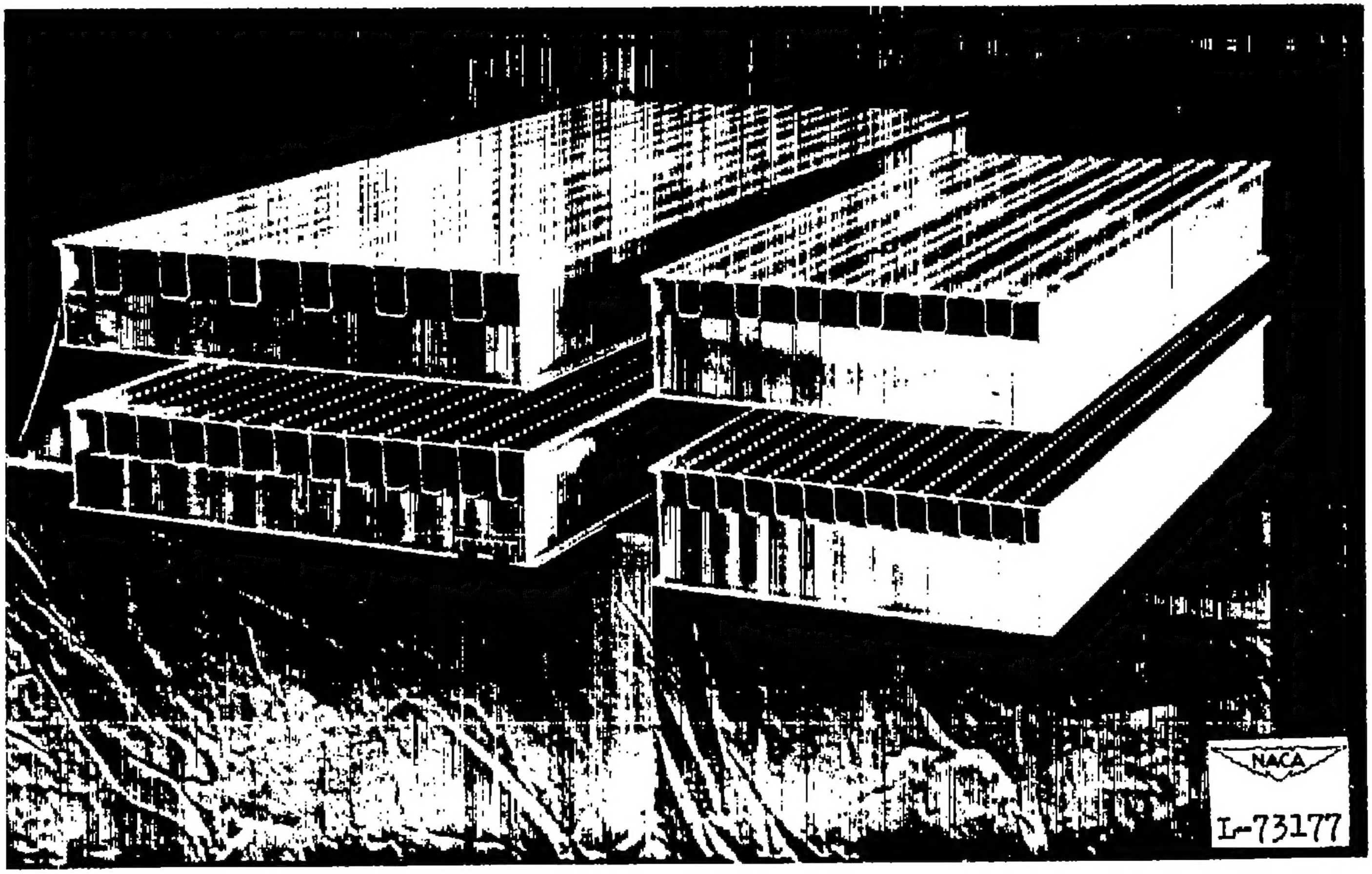



Figure 20.- Comparative Z- and hat-stiffened box beams.

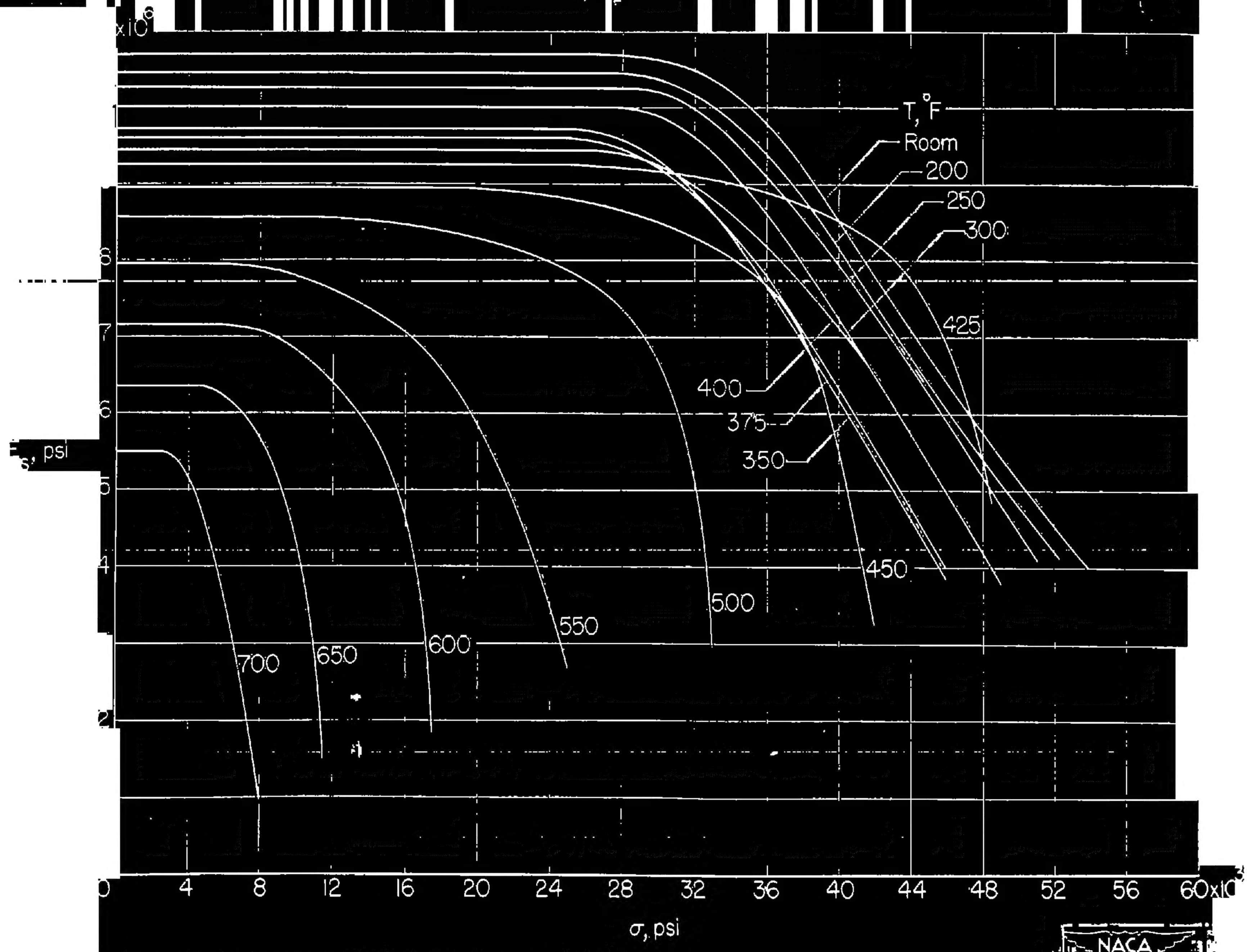



Figure 19. – Variation of secant modulus with stress for 2024–T3 aluminum-alloy sheet. 1/2 hr. exposure.

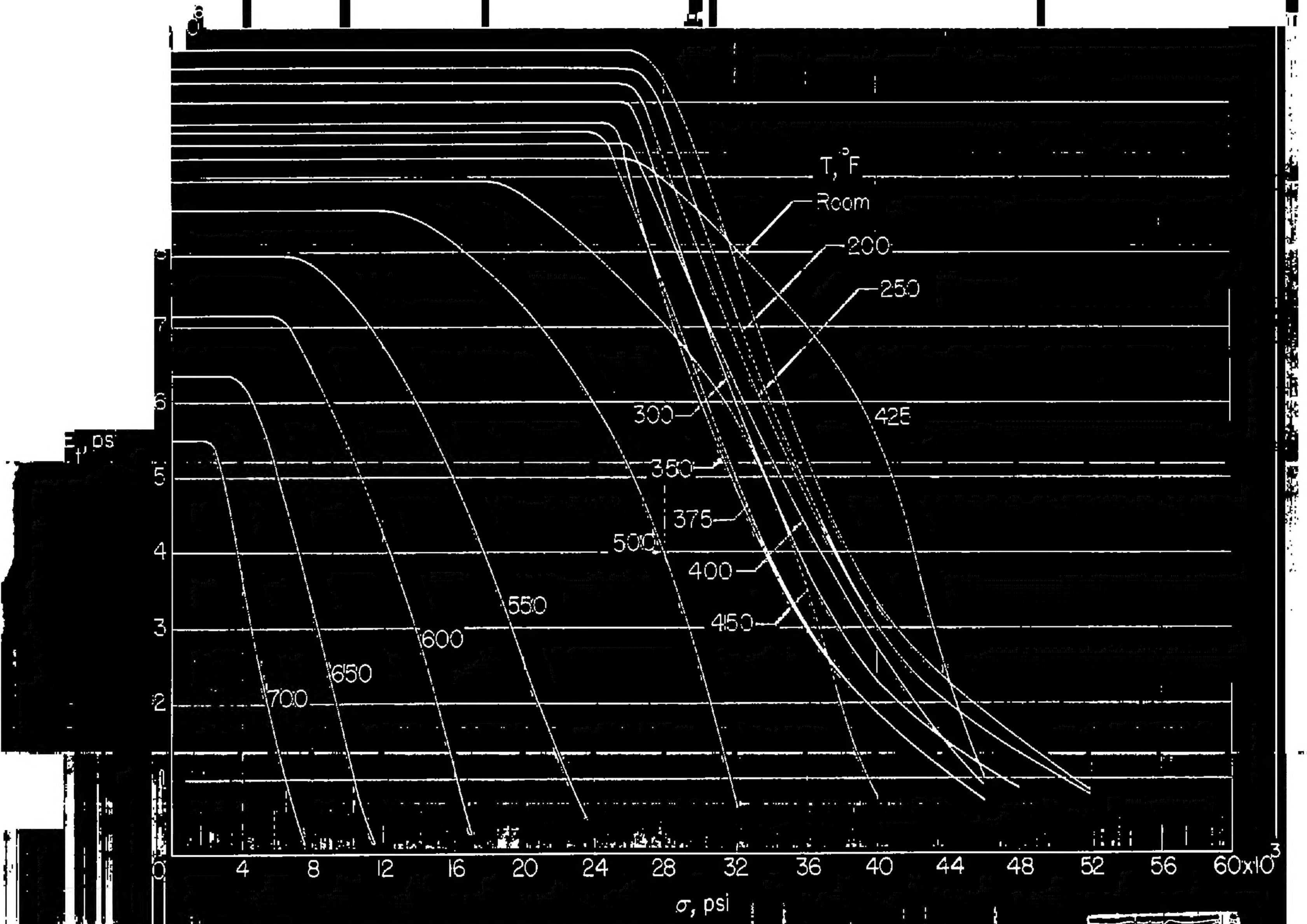



Figure 11. — Variation of tangent modulus with stress for 2024-T3 aluminum-alloy sheet. 1/2-hr exposure.

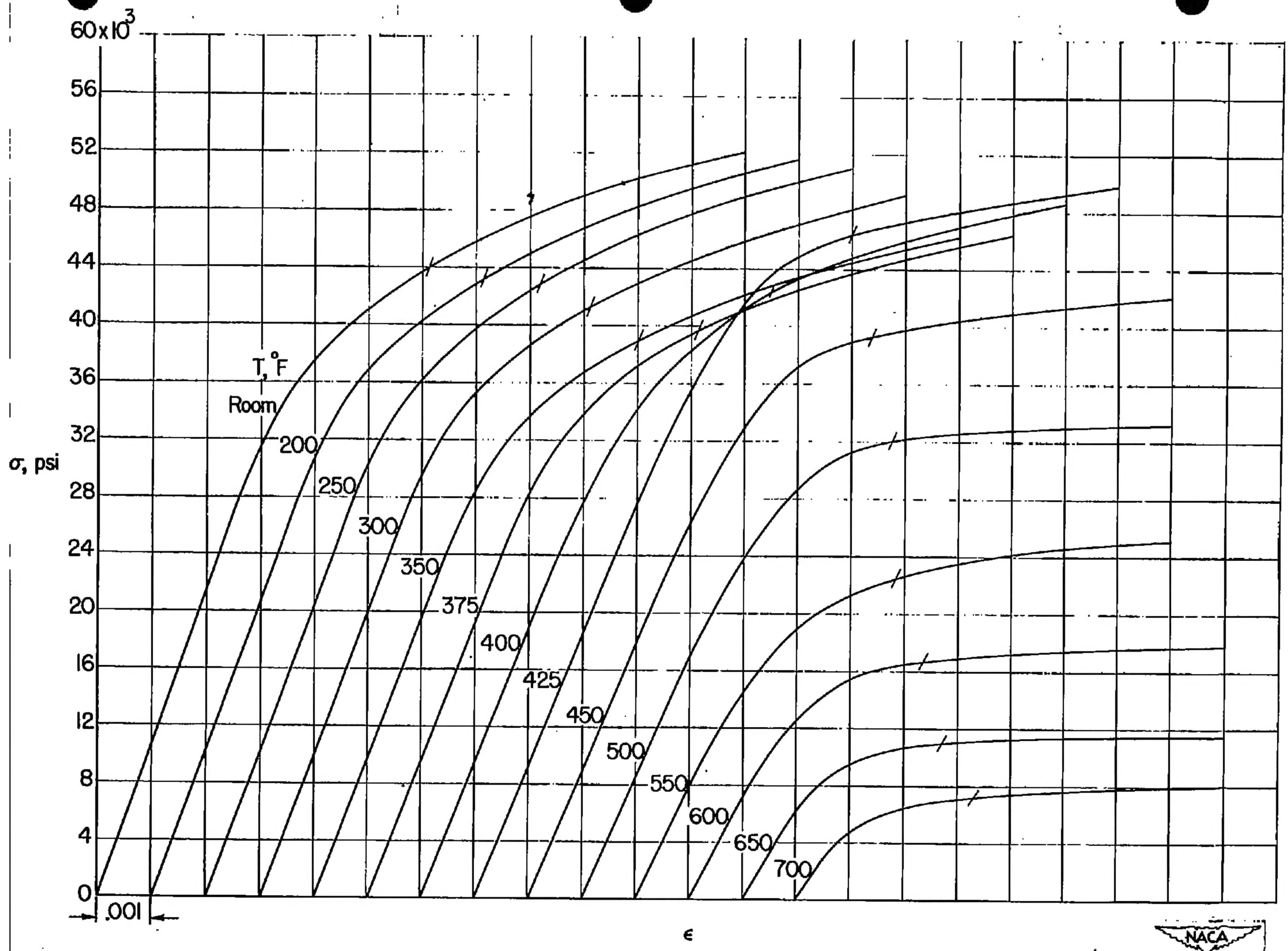



Figure 2. - Compressive stress-strain curves for 2024-T3 aluminum-alloy sheet. 1/2 hr. exposure; strain rate .002 per min.